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# FROM CONTROVERSY TO CUTTING EDGE

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A HISTORY OF THE F-111 IN AUSTRALIAN SERVICE



Mark Lax





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*This book is dedicated to the memory of*

*Air Vice-Marshal Ernie Hey*

*and*

*Dr Alf Payne*

*Without whom, there would have been no F-111C*



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# FOREWORD

The F-111 has been gracing Australian skies since 1973. While its introduction into service was controversial, it quickly found its way into the hearts and minds of Australians, and none more so than the men and women of Boeing.

Over the past 15 years, Boeing and its people have developed a special bond with this remarkable aircraft. From the commencement of our first F-111 contract, the Avionics Upgrade Program, on 15 January 1995 through to its farewell flight, Boeing has worked in close partnership with the RAAF, industry partners and the Commonwealth of Australia to ensure its technology, weaponry and airframe remain cutting edge.

For Boeing, the retirement of the F-111 signals the end of a very proud period in our company’s history. It has been a source of tremendous opportunity and great pride for our employees.

In reflecting on Boeing’s history with the F-111, there are many proud moments. We have performed significant repairs, modifications and upgrades that enhanced the fleet’s lethality and survivability, and we worked as partners to ensure it remained a formidable supersonic long-range strike aircraft for Air Force.

Most of all, as the F-111 flies into the history books, we salute the men and women of the RAAF who have operated and maintained this iconic Australian aircraft. It has been our privilege and honour to support our RAAF customer, and to work with our friends and allies to preserve and promote freedom around the globe.

Thank you for all that you have done.



**Dennis Muilenburg**  
**President & Chief Executive Officer**  
**Boeing Defense, Space & Security**

Rarely has the acquisition of one aircraft type had such a far-reaching impact on a fighting force as has the F-111 with the Royal Australian Air Force. So as the aircraft goes out of service in December 2010, it is with much pleasure that I introduce this book.

The F-111 has been an incredible success story, and the RAAF has had a love affair with the ‘Pig’ for nearly 40 years—as has the Australian public. It has been a familiar crowd pleaser at air shows and its signature ‘dump and burn’ routine will be sadly missed.

There can be little doubt that the F-111 will find its place in history for its contribution to Australian defence as the cornerstone of our strategy of deterrence. That such a complex weapon system could remain relevant is a testament to the many hundreds of men and women who flew, maintained, updated and supported the F-111 fleet over the four decades it was in service.

Despite the F-111’s success, there is also much that the RAAF has learnt from operating it - both in the air and on the ground. Perhaps the most significant was the deseal/reseal program which led the RAAF to change the way it managed its people and its maintenance practices.

As well as the RAAF’s highly skilled technicians, I single out the role that defence industry has played, particularly over the last 20 years. Without that support, the aircraft would have retired at least 10 years before its time.

I extend my personal thanks, and those of the Air Force F-111 community, to Boeing for their partnership with us on this remarkable aircraft. I particularly want to commend the company’s sponsorship of this book. I am sure the relationship we have developed during the F-111’s later years will prosper well into the future.



**Air Marshal Mark Binskin, AO**  
**Chief of Air Force**

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# PREFACE

This book covers a 50-year history—that of Australia’s first and foremost strategic weapon, the F-111. As such, it spans the experience of five generations of air and ground crew, of politicians who were both for and against the aircraft, and of defence contractors both in Australia and the United States. The aircraft touched the lives of many people, some for the better and some for worse. The challenges the F-111 brought and how they were overcome are the essence of this book.

History is about interpretation and this book is just that: an interpretation. It presents one view. As such, what I have chosen to present is not a human-interest story, nor personal memoirs or collated recollections. It presents a high-level view of why Australia got the F-111, how it was used and maintained, and what the RAAF did to keep it going for so long. In undertaking the research, I concluded that no-one knows the complete F-111 story, only the part that they played. Each has their personal experience to fall back on, and each their favourite anecdote but few have pondered the total impact of this aircraft on the RAAF, let alone analysed how it changed Australia’s view of strike and deterrence. While much has been written about the F-111 in RAAF service over the last 50 years, the majority of this material is contemporary in nature and none analyses how the aircraft forced the RAAF to mature as a Service and become the innovative and technologically sophisticated force it is today. By taking a broader view and looking beyond the aircraft itself, I hope to have filled that void.

## Acronyms

By the subject’s nature, studies of military aircraft and defence issues have a proliferation of acronyms. I have tried to reduce their use to a minimum but, where necessary, I have used the general convention of spelling out the acronym in full the first time it

is used, immediately followed by its abbreviated form, and thereafter using only the acronym. I have included a list of abbreviations and acronyms for reference.

## Metric and Imperial/US Measures

The book uses imperial/US measures of weight, height and speed for two reasons—first, imperial measures remain the international standard for aviation (feet, nautical miles, knots) and second, the book is about an American aircraft so US measures are used (gallons, pounds, feet) as the US still uses that system. Where appropriate, I have included the metric equivalent in brackets afterwards.

## Ranks and Appointments

Because the book covers a 50-year period, many of the military personnel and political figures were promoted or held numerous appointments during their tenure. For military personnel, I have used their rank at the time of the discussion and for others, their appointment.

## Limitations

There are also limitations. First, the book does not focus on any particular group—officers nor airmen, aircrew nor ground crew, industry partners nor families. This is deliberate, but in no way is intended to deny any group their rightful place in the F-111 history. Consequently, there is much still to tell about the F-111 and I am sure that such stories could fill many volumes. I hope readers forgive me if they do not find their favourite anecdote or their picture or their name. Likewise, because of the many thousands of men and women associated with the aircraft, it has not been possible to include lists of everyone. My intent was to inform the reader of each generation’s challenges with the F-111 and to explain that nothing

happens in isolation: there is usually a reason why decisions are made.

Second, by its nature, the research was restricted by lack of access to specific Australian Government and RAAF material that remains classified or other material beyond the 30-year rule still not cleared for public release under the Australian Archives Act 1983. As such, the work relies on unclassified and open sources for some parts. Where possible, supporting documentation, personal interviews and corroborating reports have been used and sources have been footnoted. Nevertheless, for errors or omissions in the work, I take full responsibility.

**Mark Lax**  
**Canberra 2010**

# ACKNOWLEDGEMENTS

A book such as this would not have been possible without a great deal of support and assistance, both personal and institutional. I am therefore extremely grateful to many people who have helped and encouraged me during the development of this project. While all are noted in the text and in the bibliography, I wish to make specific acknowledgement of some here. This study has been a pleasure to undertake, mainly because of the tremendous support I have received from all quarters. These have included serving and retired members of the RAAF and F-111 fraternity, serving and retired Members of Parliament, and scientists, engineers and academics, who all agreed the story had to be preserved. Their contribution is both acknowledged and lauded.

First and foremost, I would like to thank the sponsors of this book, Boeing Australia. It was Boeing who first conceived the TFX design in the early 1960s, and 50 years later, it is with Boeing Australia that the aircraft will finally enter its retirement. It therefore seems fitting that they take their rightful place in Australia’s F-111 history. I received strong support and encouragement from Murray Brabrook, Ian ‘Gabby’ Gabriel, Darryl Hooper and Karinne Cilento from the Boeing company, and it was David Stanfield, a former RAAF member and now Boeing employee, who suggested the title for the book. *From Controversy to Cutting Edge* is an apt description, and appropriate for both the Air Force and Boeing fraternities.

I wish to specifically thank a number of people who had a personal involvement in this F-111 story and who have kindly provided corrections, updates and extensive suggestions for improvement of the work. Many proofread early drafts and saved me from myself. Of these, the main is Dr Alan Stephens, who urged me to undertake the task and, as usual, provided expert guidance. The members of the F-111

fraternity include: Air Marshals David Evans and Ray Funnell; Air Vice-Marshals Bill Collins, Dave Dunlop, Dave Rogers, and Ian Sutherland; Air Commodore Ted Whitehead; Group Captains Milt Cottee, Bob Downing, Ron Green, and Col Spitzkowsky; and Wing Commanders Lance Halvorson, Bob Howe and Alan Lockett. Special thanks go to former Minister for Defence, the Hon. Kim Beazley; to former State Premier of Tasmania, the Hon. Robin Gray; and to Senator Bob Brown for giving of their valuable time. Others who allowed me interviews or provided me their personal papers are also acknowledged and are listed in the bibliography.

Access to official records was made all the easier by the helpful staff at several institutions. These include the National Archives of Australia, the National Library of Australia, the Australian Department of Defence, the USAF Historical Research Agency, the National Archives, UK and in particular Mr Seb Cox at the Air Historical Branch, UK. Ms Christine Hickey at the National Library and Ms Monica Walsh, the librarian at the RAAF Museum Point Cook, deserve special mention. Christine kindly translated the shorthand notes left by Malcolm Fraser in the archives, while Monica provided me access to the RAAF Museum’s F-111 holdings. Flight Sergeant Mark Eaton and his staff at No 82 Wing gave considerable help with the photographs.

Dr Chris Clark and his staff at the Office of Air Force History (OAFH) provided open access to their holdings and cleared the study for public release. The publishers, the Air Power Development Centre, first under the direction of Group Captain Tony Forestier and later under Group Captain Rick Keir, and the staff are particularly thanked for their full support. Wing Commander Keith Brent provided his usual editorial standard and publications manager, Graeme Smith produced the layout.

Finally, I wish to add my special thanks to my wife Margaret who has needled me along when I needed it, and stayed a safe distance when I did not. Thanks Marg.

**Mark Lax  
Canberra, 2010**

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ABBREVIATIONS AND ACRONYMS

AAP	Australian Air Publication	COSC	Chiefs of Staff Committee [renamed Chiefs of Service Committee in 1987]
AAR	Air-to-Air Refuelling		
ACG	Air Combat Group	CPLT	Cold Proof Load Testing
ADF	Australian Defence Force	CSP	Commercial Support Program
AEW&C	Airborne Early Warning and Control [aircraft]	DOA 87	<i>The Defence of Australia 1987</i> [1987 Defence White Paper]
AFB	Air Force Base [US]		
AFHRA	Air Force Historical Research Agency [US]	DSTO	Defence Science and Technology Organisation
AFLC	Air Force Logistics Command [USAF]		
AFSC	Air Force Systems Command [USAF]	ECM	Electronic Countermeasures
AMARC	Aerospace Maintenance and Regeneration Center [US]	ECP	Engineering Change Proposal
		ENC	Exhaust Nozzle Control [pump]
AMP	Avionics Modernisation Program [USAF]	EW	Electronic Warfare
AMTS	Air Member for Technical Services	FDA	Force Development and Analysis [Division]
ANZUS	Australia, New Zealand, United States [Treaty]	FEG	Force Element Group
ARDU	Aircraft Research and Development Unit [RAAF]	FPDA	Five Power Defence Arrangements
		F-WELD	F-111 Wing Economic Life Determination
ARL	Aeronautical Research Laboratories		
ASM	Air-to-Surface Missile	FYDP	Five-Year Defence Program
ASP 90	<i>Australia's Strategic Planning in the 1990s</i> [document]		
ASP 97	<i>Australia's Strategic Policy</i> [document]	GBU	Guided Bomb Unit [US bomb designation]
ASR	Air Staff Requirement	GD	General Dynamics
ATE	Automatic Test Equipment	GD/FW	General Dynamics Fort Worth [facility]
AUP	Avionics Update Program [RAAF]		
AUW	All Up Weight	GPS	Global Positioning System
		GSE	Ground Support Equipment
BAC	British Aircraft Corporation		
BU	Business Unit	HARM	High-Speed Anti-Radiation Missile
BUP	Block Upgrade Program	HTSA	Horizontal Tail Servo Actuator
CAS	Chief of the Air Staff	IDC	Interdepartmental Committee
CASAC	Chief of the Air Staff Advisory Committee	INTERFET	International Force East Timor
		IR	Infra-red
CDFS	Chief of the Defence Force Staff	IRAN	Inspect and Repair as Necessary
CIA	Central Intelligence Agency [US]		



JSCFADT	Joint Standing Committee on Foreign Affairs, Defence and Trade	SNCO	Senior Non-Commissioned Officer
JDAM	Joint Direct Attack Munition	SOP	Sole Operator Program
JSF	Joint Strike Fighter	SOR	Specific Operational Requirement [US]
JTF	Joint Test Force	SPO	System Program Office
lb	pound(s) [0.45 kg]	TAC	Tactical Air Command [USAF]
LGB	Laser-Guided Bomb	TFR	Terrain Following Radar
MRI	Magnetic Rubber Inspection	TFX	Tactical Fighter Experimental [later called the F-111]
MSV	Mass Simulation Vehicle	UCAV	Uninhabited Combat Air Vehicle
NAA	National Archives of Australia	UN	United Nations
NASA	National Aeronautics and Space Administration	US	United States
NATO	North Atlantic Treaty Organisation	USAF	United States Air Force
NCO	Non-Commissioned Officer	USN	United States Navy
NDI	Non-Destructive Inspection	USSR	Union of Soviet Socialist Republics
nm	nautical mile(s)	WCTB	Wing Carry Through Box
OAFH	Office of Air Force History [RAAF]	WPF	Wing Pivot Fitting
ORSRECON	Operational Requirements – Strike Reconnaissance	WSO	Weapon Systems Officer [USAF]
PAS	Precision Air Support		
PGM	Precision Guided Munitions		
RAAF	Royal Australian Air Force		
RAF	Royal Air Force		
RAN	Royal Australian Navy		
RFT	Request for Tender		
ROE	Rate of Effort		
RWR	Radar Warning Receiver		
SAB	Scientific Advisory Board [USAF]		
SAC	Strategic Air Command [USAF]		
SAM	Surface-to-Air Missile		
SEATO	South-East Asia Treaty Organisation		
SHOAMP	Study of Health Outcomes of Aircraft Maintenance Personnel		
SM-ALC	Sacramento Air Logistics Center		
SMAMA	Sacramento Air Materiel Area		

# IMPERIAL/METRIC CONVERSION TABLE

1 inch (in)	25.4 millimetres (mm)
1 foot (ft)	30.48 centimetres (cm)
1 yard (yd)	0.914 metres (m)
1 nautical mile (nm)	1852 metres (m)
1 pound (lb)	.454 kilograms (kg)
1 ton	1.02 tonne (t)
1 mile per hour (mph)	1.61 kilometres per hour (kph)
1 knot (kt)	1.852 kilometres per hour (kph)

# TABLE OF RANKS

Officers		
<i>Abbreviation</i>	<i>RAAF Title</i>	<i>USAF Equivalent</i>
ACM	Air Chief Marshal	General
AIRMSHL	Air Marshal	Lieutenant General
AVM	Air Vice-Marshal	Major-General
AIRCDRE	Air Commodore	Brigadier General
GPCAPT	Group Captain	Colonel
WGCDR	Wing Commander	Lieutenant Colonel
SQNLDR	Squadron Leader	Major
FLTLT	Flight Lieutenant	Captain
FLGOFF	Flying Officer	First Lieutenant
PLTOFF	Pilot Officer	Second Lieutenant
Other Ranks		
<i>Abbreviation</i>	<i>Title</i>	<i>USAF Equivalent</i>
WOFF-RAAF	Warrant Officer of the RAAF	Chief Master Sergeant of the Air Force
WOFF	Warrant Officer	Chief Master Sergeant
FSGT	Flight Sergeant	Master Sergeant
SGT	Sergeant	Technical Sergeant
CPL	Corporal	Senior Airman
LAC/LACW	Leading Aircraftman or woman	Airman First Class
AC/ACW	Aircraftman or woman	Airman



# 1. INTRODUCTION

Little did the Royal Australian Air Force realise just what it would get when the F-111 was ordered in 1963. Purchased by the Menzies Government as an election ploy, the aircraft remained in service for nearly 40 years as Australia's premier strategic strike force element. Bought as a political expedient, allegedly to counter the threat of a belligerent Indonesia, by the time the F-111s landed at RAAF Base Amberley 10 years later, in 1973, their *raison d'être* had evaporated. Various Australian Governments, and indeed the RAAF, have been challenged since their arrival by how best to use the F-111 and in what context, but no political party or RAAF Chief ever recommended disposal of the asset before the end of its service life. Neither did any other military aircraft program in the history of the RAAF create such controversy, generate as much political rhetoric, media antagonism or academic debate as did the F-111.

The F-111 acquisition followed an uninterrupted line of heavy bombers that the RAAF had operated from 1943. In the European theatre, RAAF airmen flew the Lancaster and Halifax bombers over the German heartland as part of the Allied strategic bombing campaign, while in the Pacific theatre, the B-24 Liberator was the mainstay of the RAAF's long-range, heavy bombing operations. Postwar, the Lincoln, a derivative of the famous Lancaster, was used in Australia and Malaya until it was replaced by the Canberra.

This book presents the F-111 story chronologically. It is convenient to break the F-111's 50-year history into decades, commencing in 1953 with Chapter 2

examining the RAAF's desire to acquire a modern, jet bomber force to replace the Canberra aircraft fleet. This, and Chapters 3 and 4 covering 1963–1973, provide essential background information on the RAAF's force structure, the attempt to go nuclear as an answer to small force size, and government policy in regards to bomber acquisition. The controversies surrounding the F-111 are also introduced, including cost and schedule overruns, and the technical problems the aircraft faced before delivery.

The assertion that the F-111 changed the RAAF is developed from Chapter 5, which covers the period 1973–1983. This is called the implementation decade, when the F-111s arrived in Australia and the RAAF came to understand the challenges involved in how to use their new bomber. This was the period post the Vietnam War when the RAAF settled into a peacetime routine. It was also the start of investment in the F-111 fleet, with the acquisition of a reconnaissance capability and consideration of how to add precision guided munitions to the RAAF inventory. As important, the development of a sound maintenance philosophy and airworthiness program during this period would be critical to ensure the F-111 remained in service for a further 25 years.

The next decade (1983–1993) was one of application and update. This period is covered in Chapter 6, with the transitioning of the aircraft from a 'dumb bomber' able to drop only unguided bombs requiring overflight of the target, into a precision strike platform relevant to modern air warfare. The RAAF also acquired four more F-111s as an attrition buy, and a precision targeting system called *Pave*

*Tack*, the Harpoon missile for maritime strike and new electronic warfare systems that ensured the aircraft would remain viable in a contemporary hostile environment. It was also the start of the many subsequent government reviews into how the Defence Force should be developed and managed, each of which affected the F-111.

The final years 1993–2010 were arguably the period of sustainment, where more questions were asked about the aircraft’s viability and applicability to Australia’s defence posture while the aircraft was also becoming harder and more expensive to maintain. The final chapter covers this period, when the fleet began to show signs of wear and new problems with airworthiness arose. It was also the time when the RAAF became sole operator once the United States Air Force (USAF) retired its F-111 fleet, and heralded the transfer of the deeper maintenance function to Boeing.

The intention to extend the life of the F-111 to 2020 was declared in the late 1990s and was seen to be bold at best and unachievable at worst. Without USAF and American industry support, the F-111 would have retired 20 years before its time, because of the intricacies of the aircraft’s construction, its highly sophisticated avionics and weapons systems, and its voracious appetite for unique spare parts. The transition from analogue technology to digital in the 1980s did not help matters either. This meant the RAAF had to carefully manage the relationship between Australia and the US to ensure supply of the technology, often by overcoming ignorance and intransigence at the lower levels within the US supply system. Likewise, the F-111 program also required considerable and constant assistance from the Defence Science and Technology Organisation, and for the last 15 years, depended upon the flexibility and technical expertise of Australian industry. However, from 2003, the RAAF turned to acquiring the Joint Strike Fighter as an F-111 replacement, and committed to retire the F-111 at the end of 2010.

The F-111 burst the myth that the Australian defence industry could not support such a complex system. Although F-111 maintenance was maintained in-house for the first 20 years by policy direction, commercialisation in the 1990s forced a change. Various commercial support activities combined with ageing aircraft issues stressed the running system, all at a time when the RAAF was downsizing its personnel numbers by government direction. Furthermore, once the USAF retired its fleet in 1998, the RAAF had to rely completely on Australian industry for support. While a great deal of learning happened on both sides, this was so successful that the model is considered a blueprint for such contracts in the future.

For the first 20 years, the F-111 challenged the RAAF to become a smart operator and to develop its own tactics, techniques and procedures that hitherto had not happened. British and some US operational doctrine were adopted without amendment for unique Australian conditions. It was also during this phase that the RAAF entered the world of precision strike by incorporating smart weapons and accurate navigation and targeting systems. For the next 20 years the aircraft was operated to the peak of its capability with further improvements, while overcoming fatigue and other ageing aircraft problems. The 1990s was the decade of the deseal/reseal program which left many maintenance workers with lasting medical conditions and cancers. The program forced a complete rethink of the RAAF’s values and how the RAAF managed its personnel. Finally, the F-111 experience well placed the RAAF to manage the transition to both the F/A-18 Super Hornet and the Joint Strike Fighter.

More than any other Australian weapon system, the F-111 had the most impact on the development of the RAAF as a fighting force, and continued to impact the RAAF throughout the aircraft’s 37-year flying career. In part, through the F-111 experience, the RAAF matured into a credible and capable air force within the Asia-Pacific region and one that is respected around the world. Consequently, the F-111

left an enduring legacy. It precipitated major changes to RAAF maintenance practice, airworthiness principles, command and control, logistics support and project management practice that otherwise may not have happened or taken much longer to emerge.

Between 1973 and 2010, the F-111 precipitated the most change upon the RAAF as an air force than any other weapon system in the Service’s history. It forced the RAAF to become more professional,

to modernise and become self-reliant. For policymakers, it forced them to specifically account for a weapon system that could finally execute Government foreign and defence policy as and when required. The F-111 was certainly Australia’s strategic weapon.

What follows is the story of this amazing aircraft in RAAF service and how the RAAF was challenged by it.

Table 1–1: F-111 Aircraft Models

Type	Number	Remarks
F-111A	<b>159</b>	For USAF TAC (42 of which were later converted to EF-111As and another 4 sold to the RAAF).
EF-111A	42	Converted F-111As used for electronic warfare missions.
FB-111A	<b>76</b>	For USAF SAC (38 later converted to F-111G status).
RF-111A	1	Modified F-111A to RF-111A prototype.
YF-111A	2	Renamed TF-111Ks which were converted for test flying.
F-111B	<b>7</b>	For the USN. Five prototypes and two production models were built before cancellation.
F-111C	<b>24</b>	For the RAAF.
RF-111C	4	Converted F-111Cs to reconnaissance versions.
F-111D	<b>96</b>	For TAC. These were F-111As with digital avionics.
F-111E	<b>94</b>	For TAC. These were also F-111As with improved engine inlets and weapons capability.
F-111F	<b>106</b>	For TAC. Much improved avionics, engines and weapons capability.
F-111G	34	Converted FB-111As. The nuclear weapon equipment was removed and digital avionics included. The RAAF acquired 15 of these in 1992.
FB-111H	0	An advanced design intended to compete for the B-1 program. None were ever built.
F-111K	46	For the RAF. Fifty were ordered but later cancelled. None were built.
TF-111K	4	For the RAF as proficiency trainers but later cancelled after two built.

Explanatory Note about the F-111 Family Tree

In order to prepare readers to be able to follow the modifications and design differences between F-111 models as discussed in this book, this short explanatory note is included.

After the Tactical Fighter Experimental or TFX project was formalised, the USAF gave the aircraft the designation F-111, ‘F’ being for fighter type and the number ‘111’ for the latest design number in a sequence commenced before World War II. There were six other prefixes later applied to the F-111 program. These were the FB (Fighter-Bomber), EF (Electronic Warfare-Fighter), GF (Ground-Fighter), RF (Reconnaissance-Fighter), TF (Trainer-Fighter) and YF (Experimental-Fighter). The FB-111 or fighter-bomber variant was intended only for the USAF’s Strategic Air Command (SAC). SAC was the USAF’s nuclear bomber force so the larger FB-111 would not be used in a fighter role. The EF-111 or electronic warfare-fighter variant was designed strictly for electronic jamming for use with the USAF’s Tactical Air Command (TAC). All EF-111s were converted from F-111As. A few early model F-111s were later given the prefix GF and were used as ground training aids. The RF-111 was the reconnaissance version operated only by Australia. The TF and YF versions were not flown operationally.

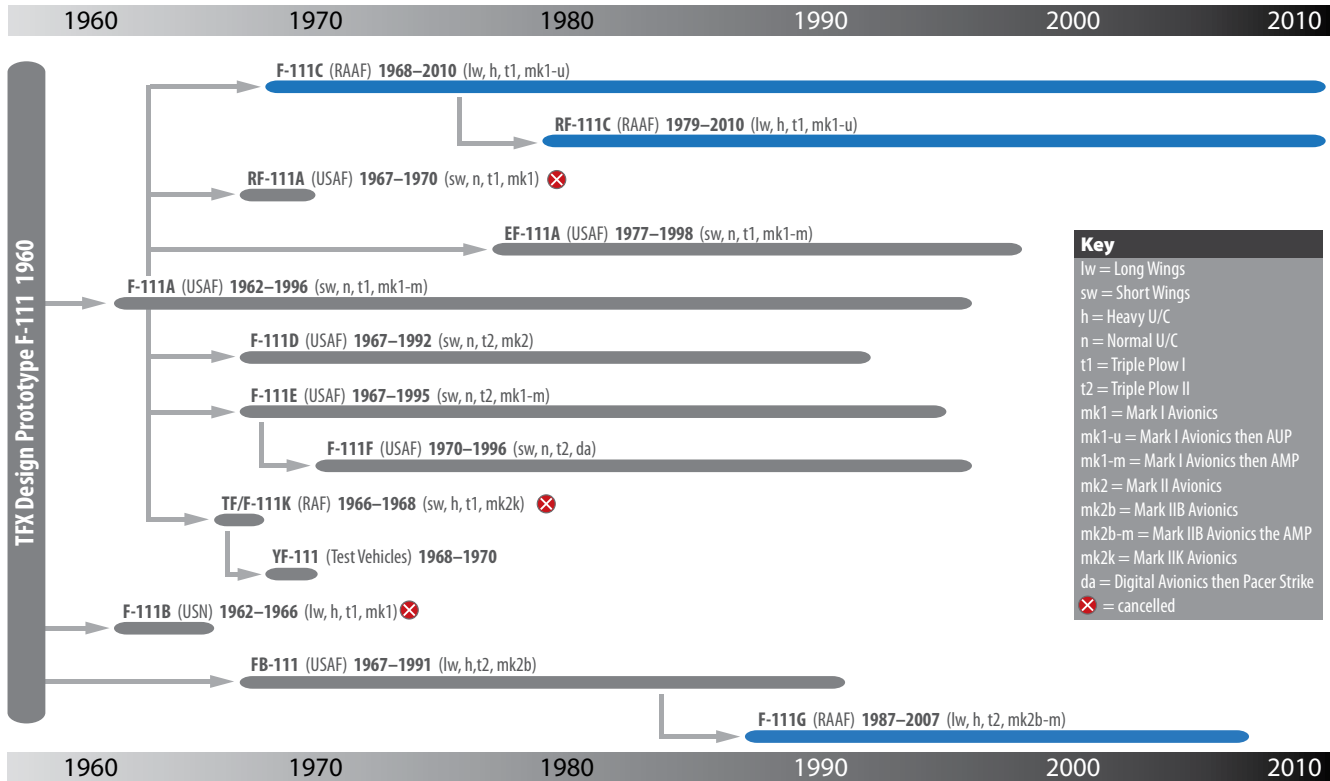
The letter after the F-111 prefix merely denotes the model as they were developed, beginning with A and ending with K (noting that I and J were not used). Eventually, 562 complete aircraft (those shown in bold in Table 1–1) were built between 1962 and 1976, and operated between 1967 and 2010.



## FROM CONTROVERSY TO CUTTING EDGE

The F-111 variants were not all developed at the same time and the following chart (Figure 1–1) is included to illustrate the development sequence:

**Figure 1–1: The F-111 Family Tree 1960–2010**



## 2. DESIRE 1953–1963

*When the F-111A does become available, two or more years later than the British aircraft, it seems doubtful whether its capabilities will be any better than the TSR2.*

The Editor, *RAF Quarterly*, 1963

Despite the *RAF Quarterly*'s comment about the American F-111A, the Royal Australian Air Force was faced with a tough choice as it fought to modernise its bomber fleet for nearly 10 years between 1953 and 1963. This chapter sets the scene and explains why the RAAF acquired the F-111 rather than the TSR2, why the nuclear option was not taken up, and why acquisition of the F-111 was controversial from the very beginning.

### **The Postwar Period**

The advent of World War II forced a coming of age on the RAAF as an independent, modern air force which had began the war as little more than a military flying club. The war brought on massive change and by the end of the conflict, the RAAF had grown to a strength of 173 622 serving in three theatres across the globe.<sup>1</sup> In September 1945, the RAAF was the world's fourth largest air force possessing immense strike power including a force of 273 US-supplied B-24 Liberator heavy bombers and various squadrons of light and medium bombers as well. Australian Liberators had a nominal range of 2300 nm carrying a 5000-lb bombload—sufficient if needed to strike most cities of South-East Asia when operating from Darwin or Townsville.<sup>2</sup>

Winning the war was one thing, but economic austerity measures enacted after the war were another and in late 1945, the Chifley Labor Government initiated a massive demobilisation and equipment disposal program.<sup>3</sup> The immediate plan for the

postwar RAAF proposed by Chief of the Air Staff, Air Vice-Marshal George Jones, envisioned a force of 35 000 personnel and 34 squadrons to be in place by June 1946. Although the plan was endorsed by the Defence Committee, the Minister for Air, Arthur Drakeford, had other ideas. The need to get Australia back to work and a growing peace mentality meant minimal funding would go to the RAAF and a much smaller air force would result. In the end, the Interim Air Force of the immediate postwar period shrunk to just under 8000 personnel and 16 operational squadrons. As before the war, there would be a heavy reliance on the Citizen Air Force or Reserve units for the air defence of Australia, peacetime training and for expansion in times of contingency. A Mobile Task Force of eight squadrons would also be raised for operations further afield, and this was to include three heavy bomber squadrons of Liberators.<sup>4</sup> The impact on the RAAF of what became 'Plan D', the fourth revision of Jones' original plan, would be felt for the next 25 years.<sup>5</sup> The RAAF had again shrunk to become a small, tactical air force with little strategic reach and little deterrent capability.

### **The Quest for a Strategic Bomber Force for Australia**

In their specific consideration of the postwar role of the bomber aircraft, the members of the Air Board agreed that: 'the primary role of bomber squadrons is to attack vital enemy targets by day and by night wherever they may be found ... targets may range from built-up industrial areas to well-concealed



RAAF Museum

**Above**

The B-24 Liberator – the RAAF’s strategic bomber of World War II.

**Opposite**

The Avro Lincoln bomber was the mainstay of the RAAF bomber force for most of the 1950s

and well-protected pin-point objectives, from fast moving land targets to ships widely dispersed at sea.<sup>6</sup> They acknowledged the role of air power in the defence of Australia, and the need to contribute to some operations further afield. Since the *raison d’être* for air forces was the ability for independent strike, an air force without a bomber force was seen as impotent.<sup>7</sup>

Faced with the prospect of defending a huge landmass and conscious of the changing strategic

circumstances in South-East Asia, the Government needed a relatively cheap, reliable option that could be pressed into service quickly to satisfy the heavy bomber requirement. The requirement was for an aircraft able to travel long distances with a medium bombload. The Liberators, used with success in the Pacific, had been sold for scrap, with their high maintenance and operating costs being among the reasons they were retired. The British Avro Lincoln four-engine bomber, at the time re-equipping the RAF, seemed the logical choice for a replacement.<sup>8</sup>

By the end of the war, the Lincoln was already in production as a development from the more famous Lancaster bomber. The aircraft also appeared ideal to the head of the Commonwealth Aircraft Corporation, Lawrence Wackett, as it could be built in Australia and thus help preserve the aviation

industry.<sup>9</sup> Best of all, the RAAF already had a plethora of trained Lancaster crews returning from Europe. However, the Lincoln became a stopgap measure as the RAAF, like its cousins the RAF and USAF, had already set its sights on a modern, all-jet bomber and fighter force. Compounding the issue of longevity in service was the Lincoln’s relatively short fatigue ‘life’ of 2000 flying hours, based on data derived from Aeronautical Research Laboratories (ARL) tests.<sup>10</sup> The Lincoln was obsolescent before it arrived but 73 were ordered with deliveries commencing in 1946.



Author

No sooner had the RAAF reduced to a peacetime cadre than the Cold War turned hot, resulting in Australia committing forces to both Korea and Malaya. While the RAAF deployed to both contingencies, it was to Malaya that the bomber force was sent. The 16 June 1948 murder of three British plantation owners by communist terrorists sparked off an insurgency war known as the Malayan Emergency, so called to ensure insurance claims to British and Commonwealth expatriates would be honoured. Because of a British request for assistance, the Menzies Government dispatched a squadron of eight Lincolns which operated out of RAF Tengah in Singapore between 1950 and 1958, but their effectiveness against communist insurgents in the end was problematic.<sup>11</sup> By contemporary aircraft standards, the Lincolns were slow, their navigation accuracy over featureless jungle was poor, and the

aircraft had no radar for targeting.<sup>12</sup> In summary, the aircraft were poorly suited to the South-East Asian region.

Despite its apparent failure in Malaya, it was not changing operational requirements that eventually forced an end to the Lincoln’s RAAF service but wing spar corrosion and metal fatigue. Based near Brisbane, at Townsville and in Singapore, long exposure to the tropical environment was not something the designers at Avro in Britain had factored in, nor was airframe and engine longevity. The RAF’s Lincolns were grounded in 1955 and, for the RAAF, the aircraft were gradually withdrawn from service from 1959. By 1961, they had all been scrapped.<sup>13</sup>

**An Advanced Jet Bomber Force?**

By the early 1950s, the RAAF was already actively seeking a more modern bomber design than the obsolescent piston-engined Lincoln, one that would propel the RAAF into the jet age. Already the Vampire and Meteor fighters had been ordered and the Lockheed Neptune maritime patrol aircraft was on the way. Missing for the RAAF were a jet bomber, and a modern transport aircraft to replace the Dakota. An indigenous aircraft construction program was also highly desirable, not just for jobs, but to further expand the defence industrial base. Cabinet first considered the RAAF’s ‘Requirements of aircraft from local sources’ paper in December 1949 and, after concerns over the cost by the Treasury were resolved, agreed to the ‘manufacture in the Government Aircraft factories of 48 English Electric B5/47 twin-engined jet-propelled bombers, at an estimated cost of A£8.35m inclusive.’<sup>14</sup> A modern transport aircraft was not then forthcoming.

Perhaps it was the name ‘Canberra’ or the fact that Menzies was personally invited to christen the first aircraft in the UK in 1951; either way, the aircraft seemed a reasonable choice for Australia at the time. It had good operational performance, especially in range and altitude, and it was fitted with modern





APDC

Doppler radar navigation equipment, codenamed *Green Satin*, a system that was then highly classified. Importantly for the defence industry, the aircraft could be manufactured under licence in Australia. Being only a two-seat aircraft, its inception also spelt the end of the air gunner aircrew category, so some manpower and training savings were also expected to be made.

The Canberra bomber had extremely good high-altitude performance allowing it to fly above potential enemy surface-to-air threats of the period and, as an added bonus, it was nuclear weapons capable should political will later permit. The product of the rapid development during the latter stages of the European War, the Canberra design was mature enough by mid-1946 to commence production in UK.

Australia's 48 Canberras were delivered between 1953 and 1958 and equipped three bomber squadrons as called for in the Mobile Task Force plan, a concept developed after the war. No 2 Squadron was the first to be reorganised in December 1953 in preparation for the jet bombers, with pilots required to do a six-week jet conversion before they were allowed to handle the new

#### Above

A Canberra bomber in its original silver finish.

#### Opposite

The air base at Butterworth shown in 1971 – a strategic asset for the RAAF.

machines. The sequence of allotment was No 2 Squadron followed by No 6 Squadron and finally No 1 Squadron when it returned from Malaya, at the time planned for early 1956.<sup>15</sup> By December 1954, the Air Board had decided to rotate No 1 Squadron early with No 2 Squadron, which eventually deployed to the Butterworth air base in Malaya in July 1958 as part of the newly formed British Commonwealth Far East Strategic Reserve (shortened to Commonwealth Strategic Reserve). This deployment was seen as Australia's contribution to meet both its forward and regional defence policies.<sup>16</sup>

The primary role of the Commonwealth Strategic Reserve was to face external threats to Malaya. It was formed in June 1953 after agreement between Britain, Australia and New Zealand, and would be available for force deployment anywhere in South-



RAAF Museum

East Asia. Australia's air contribution came once the Korean conflict had been resolved, when Menzies announced in Parliament in April 1955 the subsidiary role of the Commonwealth Strategic Reserve for the anti-terrorist campaign in Malaya.<sup>17</sup> The commitment was for a fighter wing of two squadrons, a bomber squadron and an airfield construction squadron to further develop the Butterworth air base.<sup>18</sup>

While the Canberra had a combat radius of 1100 nm (2037 km), and a payload of 6000 lb (2720 kg) of bombs, it also had significant limitations. Primarily, it lacked the capability to penetrate foreign airspace without detection.<sup>19</sup> The Canberra had no radar to guide it into the target area, had little in the way of electronic countermeasures equipment to enable it

to avoid enemy radar, and could not fly at supersonic speed, a requirement now deemed essential to avoid enemy high-performance fighters, a lesson learned from the Korean War.

By 1956, and although the Australian Canberra bomber had only been in service for two years, the RAAF was mindful of the need for a replacement to better meet Australia's changing strategic circumstances. The Canberra had been purchased at a time when the full impact of the Cold War had not been understood and, while it would satisfy operational requirements in the short term, the future was more uncertain. In making its case, the RAAF argued that: 'we lack at the present time, an effective deterrent. Replacement of the Canberra



with a modern strike/reconnaissance aircraft would overcome this and markedly improve our military potential.<sup>20</sup>

Cold War politics had now divided the East-West hemispheres. The Soviet Union had detonated their first atomic bomb in 1949 and, although China was still a decade and a half away from joining the nuclear club, their aspirations for regional hegemony were clear. The communist bloc thus represented a real and increasing threat. By 1955, the Korean War had ended in stalemate, the French had been defeated at Dien Bien Phu, and the Malayan Emergency was at a crucial stage. Australia had growing international commitments from the 1948 Australia, New Zealand and Malaya (ANZAM) Treaty, the 1951 Australia, New Zealand, United States (ANZUS) Treaty, and the 1955 South-East Asia Treaty Organisation (SEATO). These obligations meant that increases in defence spending had to be considered. Australia's Air Force priorities under endorsed government policy were given as 'the defence of the nation, international commitments as part of the Western alliance, and the air defence of Malaya.'<sup>21</sup>

Meanwhile, in 1953, the Air Staff began working on a paper called 'Strategical Appreciation of the Role and Employment of the RAAF Bomber Force in the period 1958 to 1963' in order to prepare the way for a further study of options. While it saw the role of the bomber force as 'mainly tactical', the paper acknowledged the aircraft 'may be called upon to perform strategical bombing when the occasion warrants' and 'it is estimated that under present day wastage rates the Canberra Mk 20 will be obsolescent for operational service by 1958.'<sup>22</sup> Given that the Canberra had only just entered service, was performing well, and that none had been lost in accidents, this seems a rather unusual statement. Nor was it qualified. The paper concluded that: 'The RAAF will require a new bomber aircraft for the period 1958/61' and strongly argued the case. In giving the appreciation of the current strategic context, the Air Staff proposed that any bomber for

Australia '... must be capable of carrying out any or all of the following tasks:

- Assist in operations against enemy lines of communication;
- Assist in the tactical support of land forces;
- Assist in obtaining and maintaining air superiority primarily by a campaign directed at the enemy's sources of air power in the field;
- Assist in the defence of sea communications by attacks against harbours, etc; and
- Assist in destroying the enemy's will and ability to continue the war by attacks on military, industrial and economic targets.<sup>23</sup>



RAAF Museum

#### Above

Air Marshal Alister Murdoch conducted an earlier review of bomber options.

#### Opposite

Air Chief Marshal Sir Frederick Scherger was keen to get nuclear weapons for the RAAF.

Fortuitously, the paper coincided with the Menzies Government's intention to modernise the three Services. The staff paper became the basis for a new look at Australia's strategic circumstances and led to the dispatch overseas of a team led by Air Vice-Marshal Alister Murdoch to examine aircraft replacement options covering all the roles of the RAAF at that time.

#### The Nuclear Weapons Option?

While debates on bomber aircraft continued, the idea of acquiring nuclear weapons was also raised as one solution to the small bomber force. Technologically and with manpower limitations permitting, the RAAF could rise to the occasion, but politically the idea of Australia becoming a nuclear-armed regional power was awkward. While Australia's quest to obtain nuclear weapons has been covered extensively elsewhere, it is worth summarising here because it informed part of the debate for a new, more advanced bomber for the RAAF.<sup>24</sup>

Australia held an interest in acquiring nuclear weapons from the early 1950s as a means to offset growing communist aggression as the Cold War deepened. During the period, the RAAF under its Chief, Air Marshal Sir Frederick Scherger, and the Minister for Air, Athol Townley, actively lobbied to acquire a nuclear capability, both for prestige and as a counter to small force size. Postwar downsizing and a heavy reliance on alliance relationships, first with Britain and later the US, had emasculated the size and capability of Australia's fighting forces—the nuclear option seemed a logical choice, especially with regard to regional defence responsibilities and the spectre of communism appearing on the doorstep.

Wanting nuclear weapons and getting them were two very different things. In September 1956, Townley wrote to the Australian Minister for Defence, Sir Philip McBride, first proposing the nuclear option for the Canberra bombers and Sabre fighters for their upcoming extended deployment to Malaya as part of

the Commonwealth Strategic Reserve.<sup>25</sup> The proposal was referred to the Joint Planning Committee for consideration and they concluded that: 'the effectiveness of all three Australian Services would be considerably increased if they were equipped with low-yield kilo-ton (KT) nuclear weapons.'<sup>26</sup> The United Kingdom would first be approached and if unsuccessful, a similar approach would be made to the United States. Townley's argument gained momentum within the Defence Committee especially as these weapons 'would be of considerable importance ... should a situation develop which required defensive operations in the north-west approaches to Australia, particularly if the support of the United States or United Kingdom with nuclear weapons was not available at short notice.'<sup>27</sup> Despite participating in the British atomic tests in Australia, apparently the RAAF did not realise how large, heavy and technically complex nuclear weapons of the time were, to the extent that the Canberra bomber would have had difficulty in carrying even one 'tactical' weapon, let alone the Sabre.<sup>28</sup>



RAAF Museum

Consequently, Scherger wrote to his RAF counterpart, Air Chief Marshal Sir Dermot Boyle, seeking his views on the proposal without much research being done on costs, security, proliferation policy, weapons control or even US/UK third-party access. Boyle was not in any position to offer assurances and took his time in replying. Menzies meanwhile had announced in Parliament in September 1957 that Australia’s immediate plan for defence should be in the ‘conventional field’, but the statement was open ended and discussions about acquiring nuclear weapons continued quietly in the background.<sup>29</sup> It appears that Menzies and Defence Minister McBride were never totally convinced Australia needed such a capability anyway. Menzies placed great faith in British nuclear hegemony across South-East Asia under SEATO arrangements, downplaying any support the Americans might also provide. Perhaps more importantly, the entry cost to the nuclear club also was anticipated to be very high. In a political sense, initial indications were that even covert Australian approaches were likely to be rebuffed, and despite holding a third of the natural uranium reserves in the world, Australia was in no position to develop her own nuclear arsenal.<sup>30</sup>

Discussions between the Australian and British Prime Ministers in February 1958 confirmed Menzies’ assessment. The high cost (estimated at £500 000 per weapon) combined with the lack of both US and UK Government support, meant that the path for Australia would be in conventional weapon development for the foreseeable future. The Prime Ministers agreed that while exchanges on nuclear technical developments should continue, because Britain herself was only in the early stages of nuclear weapon development, and given the paucity of Australian knowledge about nuclear weapons, ‘the time is not right’. Harold Macmillan, the British Prime Minister, raised the classic argument against the proposal saying that ‘the whole position was very delicate’, meaning that, politically, he was not prepared to make a concession, and the talks stalled.<sup>31</sup>

These discussions and Menzies’ announcement about staying conventionally armed did not prevent Scherger from being dispatched to Britain to hold ‘exploratory’ discussions with Boyle. Boyle, however, had previously let it be known that he considered it ‘unlikely’ that the British Government would make such weapons available although the British Chiefs would support such a move, so Scherger came away empty handed.<sup>32</sup>

Scherger’s similar approach to the US also met with little political support despite USAF Chief General Tom White’s statement that he would be ‘quite happy to see a cross-section of such bombs stored in Australia under American control and available for use by us [Australia] with American agreement.’<sup>33</sup> White’s offer was much the same as the emerging Canadian deal. However, White had no authority to offer anything. The American Government position under the Eisenhower Administration was quite negative, based on their wishes to contain nuclear weapons proliferation around the globe, their apparent reticence to hold nuclear weapons in ‘friendly’ territory, and a preference to use ‘clean’ (meaning conventional) bombs in any future conflict. It effectively put an end to Australia’s attempt to acquire weapons from overseas and although some effort was made to examine an indigenous nuclear weapons program afterwards, the costs and international politics made the idea impractical.<sup>34</sup>

A suspicious Labor Opposition continued to raise the spectre of nuclear weapons as late as 1962. Member of Parliament and leader of Labor’s left-wing faction, Dr Jim Cairns, claimed that the Menzies Government ‘intends to involve Australia in a secret and I think, sinister, obligation’ to acquire nuclear weapons from the US.<sup>35</sup> His attempts to embarrass the Government failed and the issue gradually faded. While the RAAF continued to look occasionally at the nuclear option throughout the 1960s, the Government was not persuaded and eventually adopted a policy of nuclear non-proliferation, signing the Nuclear Non-Proliferation Treaty in 1970.

### Meeting the Air Staff Requirement

By early 1954, the Air Staff had refined its ideas on modernising the bomber force into a formal Air Staff Requirement called OR/AIR 36, which was endorsed by the Air Board on 27 May. The in-service target date for this new bomber was to be mid-1959. The requirement also contained a condensed specification—the aircraft had to fulfil the ‘strategic bombing role, by attacking targets up to its maximum radius of action with a formidable bombload day or night’. The operational specification initially sought a range of 2000 nm, but surprisingly did not mention a specific bombload or other necessary details. The

specification was later revised to a radius of action of 1100 nm with a load of 4000 lb of bombs. The Air Staff had their minds set on replicating the British V-bomber force based on the Vulcan, with or without their nuclear arsenal, although the Vulcan could not satisfy the supersonic speed requirement, but that seemed of little consequence.<sup>36</sup>

Once the Air Staff Requirement had been endorsed, the next step was a paper-based evaluation of available options. A further staff paper was drafted called ‘The Most Suitable Bomber Aircraft to Meet Current RAAF Requirements’. It presented a table-top examination of candidate aircraft, including the Vulcan B Mk 1, the Victor B Mk 1, the Valiant B Mk 1, the Valiant B Mk 2 ‘Pathfinder’ version, and the American B-47E Stratojet. Perhaps not surprisingly, it recommended a V-bomber

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#### Below

A Vulcan bomber gets airborne. The British offered the Vulcan as an interim for TSR2.



RAAF Museum



option, an outcome that would also be reflected in the report prepared by Murdoch after he had conducted his evaluation mission on aircraft suitable for Australian conditions.<sup>37</sup>

The staff assessed the RAAF as being capable of operating two squadrons of eight aircraft each (nominally the Vulcan) out of existing airfields, meaning no additional facilities or airfield works would be required.<sup>38</sup> This was somewhat misleading as the Vulcan at 204 000 lb normal operating weight would have been too heavy for all RAAF airfields except Darwin. It was Australian Defence Secretary, Sir Frederick Shedden, who in 1956 let it be known that the V-bombers were too expensive.<sup>39</sup> Shedden was quoted in the *Financial Times* as saying that ‘the cost of some new aircraft was “fantastic” ... British “V” bombers cost £1m each and they are so intricately built that servicing had to be conducted at factories instead of flying fields. The Royal Australian Air Force would like to re-equip with a US-type.’<sup>40</sup> His comment was prophetic and his cost estimate close to the mark. Nevertheless, the push to acquire a new strategic bomber was stalled by Government and was not revived for almost 10 years. It appears, as far as the Government was concerned, the Canberras were going to do.

From 1960, the Air Officer Commanding Operational Command, Air-Vice Marshal Valston Hancock, was publicly stating that the Canberras ‘would have to be replaced before too long’. Unfortunately, he was directly contradicting the Minister for Air, Fred Osborne, who stated in Parliament the month prior that ‘for some years more we will keep our Canberras, increasing their effectiveness by improvements in navigational and bombing equipment and techniques.’<sup>41</sup> At least some investment in strike/reconnaissance remained on the agenda, but both men admitted that no suitable replacement could be identified at that time. However, within three years, two suitable contenders emerged and this raised the possibility the RAAF might actually get the strategic bomber it sought.

### A Change of Heart

By mid-1962, in a submission to Parliament, the Minister for Defence recommended against replacement of the Canberra ‘on the basis of a majority view of the Chiefs of Staff’, a recommendation which meant in effect that Australia was going out of the strike reconnaissance business.<sup>42</sup> In reviewing the budget for 1962–63 to 1964–65, the Air Board had acknowledged ‘the essential projects that cannot be committed during this programme period are, *inter alia*, 24 strike reconnaissance aircraft included in the original programme of £77.97m.’<sup>43</sup> The budget strategy had been based partly on the Joint Intelligence Committee report on developments in Indonesia and partly on the British promise of V-bombers for the Commonwealth Strategic Reserve and other SEATO commitments should trouble arise. The V-force was to be based out of Singapore and, hopefully, would remain there when needed.

Within a year, the Defence Chiefs had changed their position. A revised strategic appreciation had raised concerns about the more rapid growth in Indonesian power than originally envisaged. Indonesian President Sukarno’s growing verbal opposition to the new nation of Malaysia and his threats to use force to support Indonesia’s diplomatic aims were occupying more of their time. Australia, in these circumstances, ‘would be very foolish to discard the idea of a Canberra replacement as it offers one means available for Australia to invest its regular armed forces with some capacity for national deterrence.’<sup>44</sup>

Not helping government procrastination was a series of articles that appeared each Friday in the influential newspaper, *The Sydney Morning Herald*, throughout October 1962. Each was heavily critical of the state of Australia’s defences. The *Herald* claimed these were prompted by ‘the new strategic situation in which Australia finds herself’ and ‘the radical changes which have become necessary in this country’s defence planning.’<sup>45</sup> The articles culminated with a full page entitled ‘RAAF and RAN are Ill-

equipped for Defence’, but most damaging was the leader that read: ‘The Royal Australian Air Force is heavily outclassed by the Indonesian Air Force, both in fighter and bomber aircraft. It would not be able to defend Australia, to cooperate effectively with the Australian Army, or to mount a bombing counter-offensive’. Furthermore, the article went on to state that ‘The Indonesian Air Force has the capacity to bomb any city in Australia. The RAAF has no means of striking back at Djakarta.’ The correspondent, Guy Harriott, also called for submarines and aircraft carriers. It was the ammunition Labor Opposition Leader Arthur Calwell and his members wanted and they took every opportunity to raise it, so much so that the quote about bombing any city is often attributed to Calwell himself.<sup>46</sup> While the Minister for Air, David Fairbairn, quelled immediate debate by describing the Indonesian Tu-16 Badger bombers ‘real’ capability as being far less capable than claimed, the Opposition would continue to raise the spectre of Australia’s lack of air deterrent for another year.<sup>47</sup>

In March 1963, the Chiefs of Staff formally reversed their decision regarding the need or otherwise for an air strike capability and raised a submission to Cabinet seeking its agreement to consider new options. It prompted a complete Defence Review that Menzies presented to Parliament on 22 May 1963. In his statement in the House, Menzies announced a A£200m increase in expenditure over the next five years.<sup>48</sup> He also foreshadowed yet another evaluation team to be sent overseas to look at bomber candidates and raised the possibility of a gap-filler between the early demise of the Canberra and the in-service date of this new capability. The evaluation team was to be led by the new Chief of the Air Staff, Air Marshal Sir Valston Hancock, and was to report by the end of the year. Menzies was careful to note that the Canberras were ‘by no means obsolete’ and were still in front-line use with the RAF and the North Atlantic Treaty Organisation (NATO), and that there were ‘great financial problems’ with the current budget. In support of his Prime Minister, and among other statements made to the public,

Minister for Air, David Fairbairn, penned an article for the influential *RAF Quarterly*, describing what the Government was doing to rearm the RAAF, with emphasis placed on the bomber role being under serious consideration.<sup>49</sup> Menzies’ intention was clearly to forestall further Opposition censure.

### TSR2 or TFX?

On 1 May 1960, an American U-2 high-altitude reconnaissance aircraft flown by CIA pilot, Francis Gary Powers, was shot down over Sverdlovsk, in the USSR, causing a deeper freeze in already frosty US-Soviet relations. Shortly after, the full story broke in *Time* magazine as the loss sent shockwaves throughout the whole US Administration, not just the Defense Department and intelligence community.<sup>50</sup> Although the exposure of US spy flights was bad enough, the US realised that the Soviets had developed a surface-to-air missile that could hit aircraft flying above 60 000 feet. It meant that, almost overnight, high flying subsonic heavy bomber forces would have to be considered vulnerable to enemy air defences. The US Strategic Air Command (SAC) and RAF Bomber Command’s concept of massed bomber formations of nuclear-armed B-47s or Vulcans heading unmolested deep into Soviet territory was found wanting. Already these aircraft, together with Australia’s Sabre and Canberras, were looking obsolescent.<sup>51</sup>

The outcome of these Soviet advances forced a rethink of strategic bombing concepts of operations, as well as the conduct of covert espionage flights. In the former case, to be able to attack strategic targets in heavily defended areas, strike aircraft would now have to be able to fly at very low level, under the enemy radar, and penetrate into the target at supersonic speed. Stand-off weapons would also be needed for both conventional and nuclear attack.

The changing world situation also prompted a reconsideration of the Air Staff Requirement (ASR) for the replacement bomber. Wing Commander David Evans, holding the important post of

Operations Requirements – Bomber, had the job of producing an updated specification to meet the new circumstances. He recommended an aircraft that could fly 1500 nm, carry a 14 000-lb bombload and fly at Mach 2 (twice the speed of sound). His boss, Air Commodore Colin Hannah, pointed out that there was no aircraft available that could meet this requirement, so the range was reduced to 1100 nm.<sup>52</sup> The new bomber would also be expected to fly under the enemy’s radar screen and into the target area. Thus, the updated ASR 36 now prescribed a minimum radius of action on such a profile with five minutes loiter time as 900 nm, with a desired radius of action of 1100 nm. Bombload for this mission was specified as four 1000-lb bombs. Table 2–1 lists the broad ASR 36 requirements.<sup>53</sup>

USAF calculations on the same mission profile gave their new bomber proposal a predicted radius of action of 1190 nm carrying 12 Mk 82 bombs (6000 lb) and two 600-gallon drop tanks. This would more than meet the specifications. However, it was not just the US that could now satisfy the specification as the British already had a new contender. Thus, two options emerged, either of which would make an ideal replacement for the Canberra and each would be available sometime in the late 1960s. The first was the British Tactical Strike

Reconnaissance aircraft No 2 or TSR2, and the second the American Tactical Fighter Experimental aircraft or TFX (later to be called the F-111). Both options led to considerable debate.<sup>54</sup>

**The TSR2 Debacle – Politics in Extremis**

The first option that appeared to meet the Air Staff Requirement was the TSR2. In the early 1960s, the British aircraft industry was in turmoil. The immediate postwar years had been very good as prospects for military aircraft sales were excellent, so good in fact that there were at least 20 prime contractors all vying for business. The 1957 Defence Review released by UK Defence Minister Duncan Sandys effectively ended many of the British aircraft projects as it postulated that missiles and nuclear weapons would replace the manned aircraft. By 1960, the number of manufacturers had halved. For those remaining, it was a struggle for survival as Air Ministry projects were progressively cancelled and overseas markets either turned towards their indigenous manufacturers or to US designs. It would be another decade, and only then after numerous company amalgamations, before the British military aviation industry had a significant combat aircraft to produce.

**Table 2–1: ASR 36 Requirements**

Parameter	Requirement
Speed	Mach 2.0 at 50 000 ft Mach 0.9 (min) at 200 ft
Radius of Action (ROA)	900 nm (min) including 300 nm at low level Optimum ROA is 1100 nm including 350 nm at low level
In-Flight Refuelling	Capable. One refuel to achieve ROA
Weapons Load	Min: 2 x ASMs or 4 x 1000-lb bombs to achieve ROA Desirable: 2 x ASMs, 6 x 1000-lb bombs, or special (nuclear) stores
Reconnaissance	All weather – photographic, radar and electronic sensors
Take-off and Landing	6500 ft take-off roll at max AUW and ISA + 25°C 6500 ft landing roll after clearing a 50-ft obstacle at max landing weight



RAAF Museum

**Above**

TSR2 prototype XR219 under the controls of test pilot Roland Beamont. Like many, Beamont was disgusted with the cancellation of the project.

One project that managed to escape the initial cuts was the TSR2 which was born out of competitive designs between the Vickers and English Electric companies. The British Government had forced an amalgamation of both to form the British Aircraft Corporation or BAC in 1960. General Operational Requirement GOR 339 had been issued by the British Air Staff for a Canberra replacement towards the end of 1957 and the ‘go-ahead’ given in early 1959. During that year, the operational requirement was refined into OR 343 to cover a number of emerging designs, including the TSR2.<sup>55</sup> The TSR2 had immediate appeal and, after further development, a contract for full-scale development was issued on 7 October 1960 for a pre-production run of 20 aircraft that was later increased to 30. The RAF’s initial intention was to order 138, with final delivery in 1973.<sup>56</sup>

The TSR2 design was a revolution in aerodynamics and systems engineering. It had a responsive flight control system to help fly the aircraft, terrain following radar (TFR) and an integrated navigation-attack system. It was to be both nuclear and conventionally armed and a reconnaissance pallet was under consideration. The specification called for a speed of Mach 1 or better at low level and Mach 2+ at height. It was to have a radius of action of 1000 nm on internal fuel; and a range of up to 10 000 lb of internal and external stores could be carried. At 89 feet long and with a span of just 37 feet, it was pencil thin, unlike anything designed to date.<sup>57</sup>

But the TSR2 did not have full support. In 1962, British Chief of the Defence Staff, Lord Louis Mountbatten, was pushing the rival Buccaneer aircraft and the UK Chief Defence Scientist, Sir Solly Zuckerman, was showing little enthusiasm for the aircraft. The project looked doomed. It was also coming under mounting criticism from the opposition British Labour Party. BAC executives, however, were determined to keep the TSR2 alive





Sea Power Centre

**Above**

Lord Louis Mountbatten meeting sailors on HMAS *Melbourne*. As British Chief of the Defence Staff, he was not in favour of the TSR2 but preferred aircraft carriers with Buccaneer aircraft.

and one way to do so was to seek export sales. The company got notice that Australia was finally about to make a decision on their Canberra replacement so a stream of representatives, including company Chairman, Sir George Edwards, and military aircraft sales manager and test pilot, Jeffrey Quill, made several trips to Australia selling the TSR2's advantages.<sup>58</sup> Should a deal be done, delivery would be from 1968 and Australian industry would have a share in construction.<sup>59</sup> Scherger and Hancock were feted during their evaluation visits and Hancock was later to admit the TSR2 was an impressive aircraft, but he later recalled, the Australian airmen were hardly converted.<sup>60</sup>

The aircraft first flew in September 1964, three months before its F-111A rival, but it continued to be under immense political pressure, particularly on the rapidly escalating cost. It also had technical problems with the engines and undercarriage, and while these could be overcome, they added further delays and increased the development bill. The main problem with Australia buying the TSR2 was not just cost (which at UK£2.1m per aircraft was

high), but aircraft numbers. The RAF had not yet ordered any, and the RAAF had become nervous. The last thing Hancock and the Air Staff wanted was an order for 24 TSR2 aircraft with no other customer—it was tantamount to spending vast sums for nothing, as such a project would likely fail anyway. Spare parts and support alone would soon dry up, notwithstanding any Australian industry participation. Not helping matters for the British was the attitude of Mountbatten, who virtually told Scherger and Hancock that the aircraft would not survive, and again pushed the Buccaneer as an ideal substitute, and of Zuckerman, who favoured US technology.<sup>61</sup>

The problem with Mountbatten's approach was that the Buccaneer would not have come close to meeting Australian requirements. The Royal Air Force Chief was of like mind, noting that while the Buccaneer might do for sailors, the RAF 'needed their own aircraft – the heavier, more sophisticated and more expensive TSR2'.<sup>62</sup> In his official biography of Mountbatten, Philip Ziegler states that Mountbatten did his best to oppose the TSR2 without appearing to do so. Mountbatten urged Zuckerman to lobby the Defence Minister, Harold Watkinson, against the aircraft and eventually wrote directly to him, noting that 'if he were CAS, he would have gone for the improved Buccaneer or for some radically new innovation like Barnes Wallis's variable geometry plane'.<sup>63</sup> A more damning indictment of Mountbatten's duplicity is found in Stephen Hastings's book, *The Murder of the TSR2*, which claims that after a meeting in April 1963 with Mountbatten, Scherger 'left this country with his confidence in TSR2 virtually destroyed'.<sup>64</sup> This message certainly made Prime Minister Menzies' decision to buy American easier. Despite rumours circulating at the time that Scherger was to blame for the TSR2's demise, it was the British Secretary of State for Defence, Denis Healey, who finally sealed its fate.<sup>65</sup>

On 16 October 1964, Harold Wilson and the Labour Party came into office in Britain, with policies to kill off what they called 'prestige projects', including

the Anglo-French Concorde supersonic airliner and a range of military programs.<sup>66</sup> Thwarted by the French over axing Concorde, the Wilson Government turned its attention to the TSR2 which was still suffering large cost overruns and technical difficulties. Chief test pilot Roland Beamont admitted the TSR2 did have its teething problems, but he felt these were not a reason to stop the program. Writing just after project cancellation, Beamont recalled: 'Three areas of technical trouble were encountered, none of them exceptionally difficult to resolve but each requiring valuable months to investigate and correct'.<sup>67</sup> Although BAC engineers were working to fix the bugs, on UK budget day, 7 April 1965, the Government announced all production and testing was to cease and all construction jigs were to be destroyed. The people at BAC were dumbstruck and the whole sorry saga was to leave lasting bitterness, some of which went against the RAAF who had not selected the TSR2.<sup>68</sup> Had the TSR2 gone into RAF service, there is no doubt it would have been an effective strike aircraft, but with limited numbers it would not have lasted, even with NATO support. Ironically, by the mid-1960s with a change of Government, the RAF got Buccaneers and the Royal Navy lost its fixed-wing aircraft carrier—not what Mountbatten had in mind.

Despite the emotion and finger pointing, particularly in the British media, in the final tally, upwards of £750m had been spent on TSR2 development and retrospective analysis has since shown this is really what caused its demise.<sup>69</sup> The final word on the TSR2 and its fate should perhaps rest with the RAF Air Marshals, who as young officers, were so hurt by its cancellation. In 2004, when asked about the TSR2 saga, Marshal of the RAF Sir Michael Beetham admitted that 'TSR2 would have been the best technical solution, but I agree that it was right to cancel it because the costs were simply out of control and we just couldn't afford it'.<sup>70</sup> With that, the TSR2 debate was finally put to rest.

As far as the Australian TSR2 debate was concerned, cost and number of airframes to be built (and

therefore to be supported) were always the main show stoppers. Hancock, when later asked about the TSR2, said the biggest factor was cost. He added:

Townley went straight to TFX, General Dynamics. They quoted him the price that they'd quoted me, and Townley came back and recommended to Cabinet that we should buy the TFX, sight unseen, at this very attractive figure which I knew would be inaccurate. However, that's the way politics goes.<sup>71</sup>

Menzies, however, was a shrewd politician. On 14 October 1963, he cabled the British Prime Minister asking about a possible last-minute deal on the TSR2. His request covered price, credit, delivery date, stopgap measures, and TSR2 for the RAF. In what was bad timing, British bureaucrats dithered and redrafted the Prime Minister's response several times over and it did not go off until 23 October—just a day too late.<sup>72</sup> Menzies also realised it was in his best interests to keep the British informed of decisions before the story broke in the press and was well aware that his counterpart had been waiting for news of a possible sale of TSR2 to Australia. British Prime Minister Harold Macmillan had just retired due to ill health, so Menzies immediately cabled new acting British Prime Minister Alec Douglas-Home to advise him that Australia would not buy the TSR2. The decision was met with some dismay given the state of British aircraft industry and caused anger in the media, but it cannot have been a surprise.<sup>73</sup>

**The Birth of the TFX**

The second option that appeared suitable as an Australian Canberra replacement was the Tactical Fighter Experimental or TFX. By the late 1950s, in the closing months of the Eisenhower Administration, the USAF was seeking to replace the F-105 Thunderchief and B-58 Hustler nuclear bomber with a new tactical aircraft with greater range, accuracy and reliability. Newly appointed Commander of Tactical Air Command (TAC), USAF General Frank Everest, sought an aircraft that would give him a conventional strike as well as

nuclear weapon delivery capability. While the SAC held the principal nuclear strike role, the detonation of a Soviet nuclear device in 1949 meant nuclear retaliatory strike entered mainstream USAF doctrinal thinking and, therefore, received the lion's share of the budget. Everest wanted his Command to be part of the emerging Cold War nuclear deterrent strategy, arguing that a limited nuclear war in central Europe would involve TAC as much as SAC. While SAC had global reach with the B-47 and B-52 aided by KC-135 aerial refuellers, TAC had short range, limited payload F-100, F-101 and F-105 fighter-bombers that could prosecute a very limited nuclear mission. By the late 1950s, the massive and expensive North American XB-70 Valkyrie design was being developed for SAC, and there was no other aircraft that could fulfil Everest's nuclear and conventional weapons delivery requirements. He wanted an aircraft that had range, payload, penetrating power and speed. The 'Century Series' fighters available or in development were not in contention, and neither was the Navy's A-5 Vigilante, a carrier-based nuclear bomber.<sup>74</sup>

Fortuitously, Everest's TAC Headquarters was at Langley Air Force Base in Virginia and close to the National Aeronautics and Space Administration (NASA) Langley Research Facility. Here John Stack, an aerodynamic engineer who had been working on variable geometry designs, was able to hold regular discussions with Everest and his staff on the possibilities of developing a variable geometry aircraft that would satisfy the performance parameters demanded by the General. Stack had solved the problem of managing changes to an aircraft's centre of gravity as the wings swept fore and aft, a problem that had plagued all earlier designs.<sup>75</sup> By placing the wing pivot points well outside the aircraft centre-line, changes to centre of gravity could be minimised. There was an added advantage: the extension of the fuselage frame outwards increased the area that created aerodynamic lift. Consequently, Everest was convinced, and released Specific

Operational Requirement (SOR) 183 on 14 July 1960 which spawned the TFX program.

The SOR was a radical departure from previous high-performance aircraft specifications. Everest wanted to prosecute TAC's three basic missions, namely: 'To obtain and maintain air superiority over the battlefield, to disrupt enemy forces by interdiction, and to provide close support to the Army.'<sup>76</sup> Despite paying lip service to this ingrained TAC dogma, Everest really wanted a new design that could do much more. He wanted an aircraft that could penetrate enemy defences at high speed and at low level, and one that could operate from short, rough airfields. He wanted it to fly unrefuelled across the Atlantic (a range of over 3300 nm or 6107 km) and carry a wide range of stores.<sup>77</sup> It had to have a dash capability of Mach 1.2 for 400 nm (740 km) at low level and fly at Mach 2.5 at height. All this in one aircraft was going to present designers with a headache.

Meanwhile, the larger aircraft manufacturers in the US had been studying USAF requirements independently, many hoping to pre-empt any SOR for a new tactical fighter. The Century Series aircraft, other than the F-105 Thunderchief, had been



GD/FW

**Above**  
One of several General Dynamics designs for the new TFX project.

designed for high-altitude, supersonic interception, so the smarter engineers and marketing men realised there was a looming capability gap. The United States Navy (USN) too was seeking a new long-range fighter capable of fleet air defence (a role they called FAD) to operate well forward of the carrier battle group vulnerability zone. They had released their own SOR for their FAD aircraft, but with the arrival of new US Secretary of Defense, Robert S. McNamara, the development strategy for both the USAF and USN soon merged. On 14 February 1961, McNamara formally directed the Services to study the development of a single aircraft type, even if some compromises had to be made. McNamara had been the President of the Ford Motor Company and had turned its fortunes around by implementing modern business practices. Mass production, simplicity and commonality of parts were the keys to McNamara's automobile success, so he set about applying the same principles to the aerospace industry. While developing the TFX as a joint Service aircraft would be a technical challenge, major philosophical differences in USAF and USN requirements guaranteed there would be trouble.

The first large aerospace company to address the TFX design was Boeing. Their development department had been experimenting with a variable sweep wing concept and was therefore well placed to respond to both General Everest's call and that of the Admirals. Boeing executives also had the foresight to speak with the staff at both NASA Langley and TAC Headquarters during the late 1950s, as their military aircraft division was seeking new opportunities. Their Model 818 was a swept wing design with side-by-side crew seating, and with the engine intakes set above the wings. These were all revolutionary features. The company got as far as developing complete scale drawings, produced full-scale mock-ups and had started wind tunnel testing. They were at least a year ahead of their rivals.<sup>78</sup>

Their main competitor was the General Dynamics Convair Division. The company was based in Fort Worth, Texas, and after production ceased on the

B-58 Hustler, was desperately looking to secure a defence contract as it was in some financial trouble. The company began work on their TFX design once the SOR was released. After McNamara had insisted on a joint USAF-USN aircraft, they teamed with Grumman, best known for a family of successful navy aircraft. McNamara ordered development beyond the scoping stage on 7 June 1961 and both Boeing and General Dynamics accepted the challenge.

### The USAF-USN TFX Debate

From the moment it was born, the TFX aircraft would be controversial. Controversy over design features, contractor selection, cost, roles, civilian interference and strategic doctrine all would play out in the US Congress, even before Australia had made its decision. The prospect of a US\$2.2b contract for upwards of 1700 aircraft had all the major US military aircraft manufacturers interested in participating. Six contenders submitted initial proposals,<sup>79</sup> but after two rounds of the USAF Source Selection Board, these were soon refined to just two: Boeing and General Dynamics.<sup>80</sup>

While both solutions broadly met the specification, the Boeing option was judged superior in almost every aspect. It was no surprise that the Source Selection Board first recommended the Boeing solution for the USAF, but McNamara directed two further rounds of competition, primarily because he wanted a single TFX for both the USAF and USN to save costs and for commonality, something he felt that Boeing had not delivered. He was strenuously opposed by both Air Force and Navy Chiefs who expressed their doubts that one aircraft could satisfy both Services' requirements. McNamara also felt that the General Dynamics option appeared to hold less risk even though it was more expensive.<sup>81</sup>

The first problem was that the USN did not like or want either proposed design, even though the Boeing design was closer to their requirement than that of the USAF. Like the USAF, the Navy was considering its own next generation of fighters and had in mind



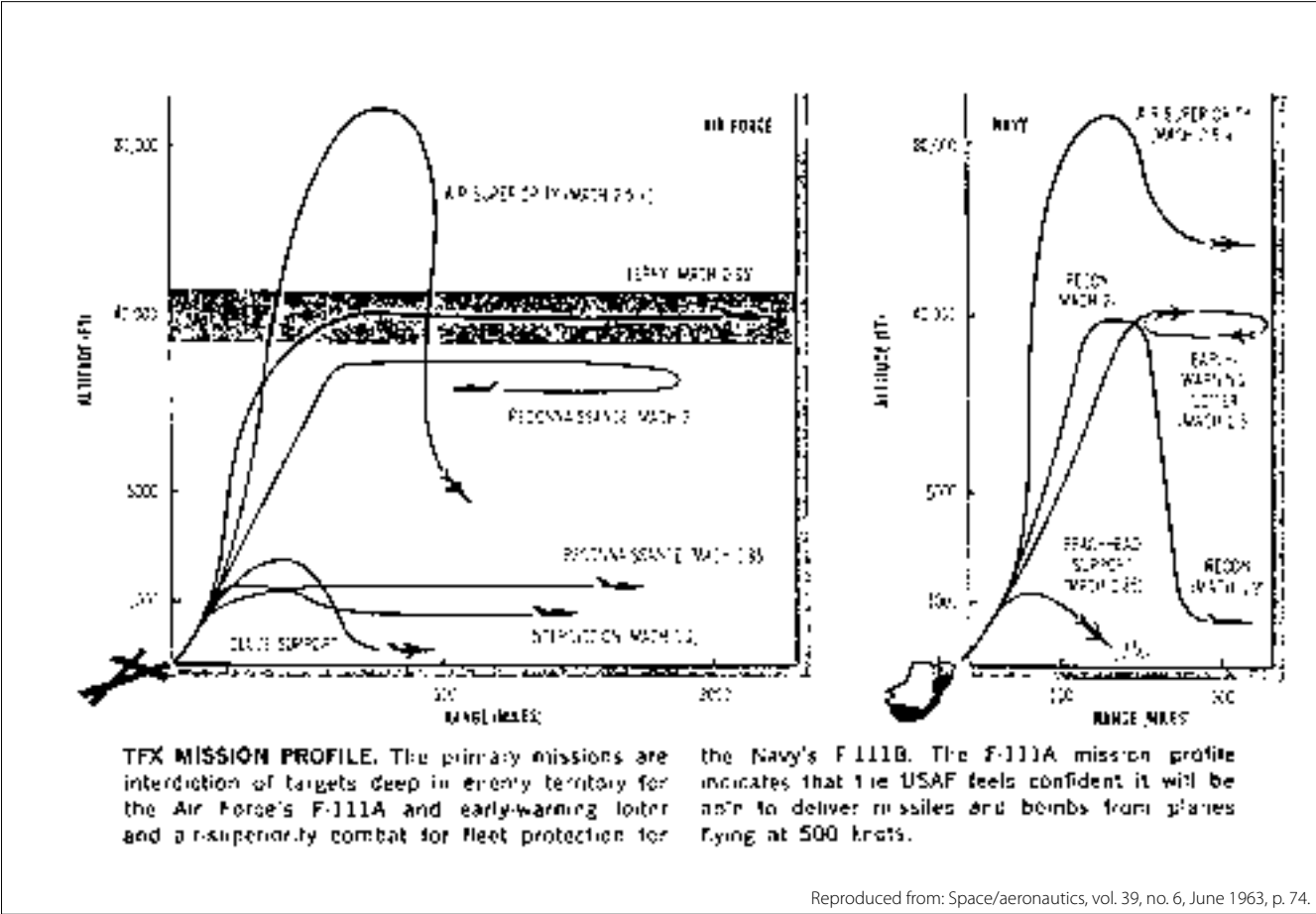
a new development called the F-6D Missileer. The Missileer was designed specifically for long-range air defence to defeat enemy aircraft well before they got in range of the surface fleet. This meant supersonic performance, a good radar, high manoeuvrability and carriage of at least four Phoenix air-to-air missiles. However, with McNamara's arrival, the Missileer program was cancelled and the USN was forced to consider a naval version of the TFX. Both USAF and USN had different requirements and intended different mission profiles as shown in Figure 2–1, but both were expected to compromise, so the USAF would get the F-111A version, the Navy the F-111B.<sup>82</sup>

McNamara's aim was frugality through commonality and was based on his experience from his time as a Chief Executive Officer where every dollar counted. He also surrounded himself with 'whiz-kids', clever

young graduates who advised him on every matter to do with his portfolio and who ignored the years of experience in the military staff. They decided neither candidate met requirements, disregarding the Source Selection Board's recommendation. They insisted on a second run-off involving a further four competitions. In every case, the new Source Selection Committee, which now had Admirals as well as USAF Generals on the panel, selected Boeing. The Boeing version came out best technically and was cheaper. Not surprisingly, on 2 November, the Committee voted unanimously for the Boeing solution.<sup>83</sup>

Despite the rigorous Pentagon selection process, McNamara disagreed with the findings. He considered on-costs, developmental risk and simplicity of design to be more important drivers of

Figure 2–1: TFX Mission Profile



Office of the Secretary of Defense

**Above**  
US Secretary of Defense Robert S. McNamara forced the USAF and USN to look at one aircraft type.

**Below**  
Boeing's TFX design for the USN. Most obvious are the engine intakes above the wing and tandem seat arrangement.



Boeing

likely success, so on 24 November 1962 the Pentagon announced the award of a US\$439m contract to General Dynamics to develop the new fighter. While, no doubt, General Dynamics-Grumman executives were delighted, Boeing executives and the military staffs were stunned. They could not believe that after four rounds of selection and refinement in which the Boeing option was unanimously recommended in every instance, they had missed out on potentially the biggest defence contract ever.<sup>84</sup>

For over a year, the aviation media heavily criticised the contract award. Headlines such as 'The \$7-Billion Contract that Changed the Rules' and 'TFX Probe to Focus on Possible Conflict' were rife.<sup>85</sup> Boeing was seen as a victim of Washington power politics, especially when Boeing's TFX was a clear winner. It was the start of animosity between the politicians, the military, industry and the media over the TFX program that was to continue for more than 40 years.

After such damning headlines and public outcry, Congress called for their own investigation.<sup>86</sup> Was the decision politically motivated? Certainly, General Dynamics was based in Texas, the state represented by Vice President Lyndon Johnson, and was in dire need of a large contract to stay afloat after the end of the B-58 Hustler program.<sup>87</sup> By 1962, according to one aviation insider, General Dynamics Fort

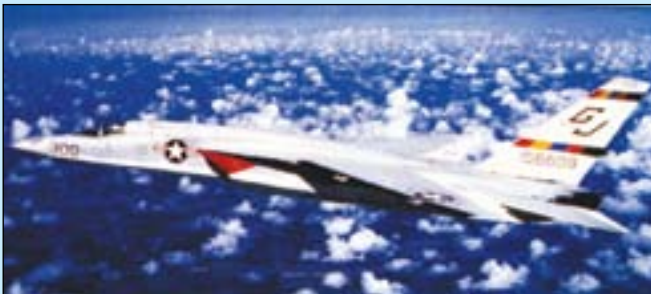
# THE OPTIONS



The French option – the Mirage IV, a two-seat nuclear bomber version of Australia’s Mirage fighter.



The F-4C Phantom was chosen by the US Tactical Air Command to equip its fighter-bomber units from 1962 and was considered on more than one occasion.



The North American A-5 Vigilante, the USN’s nuclear bomber selected by Hancock as the RAAF’s Canberra replacement.



The BAC TSR2. This aircraft was a close contender for Australia’s bomber replacement



GD concept drawing of the RAAF’s F-111A. GD had several early designs.

Worth Division was close to bankruptcy, having lost US\$27m in 1960 and \$143m in 1961. According to Richard Austin Smith, ‘unless it [General Dynamics] gets the contract for the joint Navy-Air Force fighter (TFX) ... the company was down the road to receivership.’<sup>88</sup> *Time* magazine was later to state that the F-111 saved General Dynamics, taking the company from a total corporate loss of US\$214m in 1961 to a profit of US\$58m by 1966.<sup>89</sup> Or was it that McNamara just wanted to remind the Admirals and Generals that civilian control of the military was laid down in the US Constitution and that he was in charge? He was also determined to reform Defense acquisition and this would be his first run.<sup>90</sup> Whatever the reason for the choice, it prompted Congress to hold extensive hearings during 1963 and again in 1970. What the Chair, Senator John L. McClellan, thought might take ‘five or six hearing days’ ended up taking over 10 months. Try as they might, the Congressmen could not substantiate claims of bias or coercion. Nor could accusations of political leverage or corruption be proven. According to sworn testimony before the Committee on Government Operations, the Defense Secretaries all stated the award was made to General Dynamics for ‘cost and technical reasons.’<sup>91</sup> After hundreds of hours of testimony and a 10-volume report, the Committee recessed after President Kennedy was assassinated. The hearings never resumed or brought down findings, so the contract stood and General Dynamics survived.<sup>92</sup>

## The Hancock Strike/Reconnaissance Evaluation Team

Once Cabinet had approved the RAAF to examine options to replace the Canberra, Hancock wasted little time in assembling a team of seven, including technical, operational and equipment experts.<sup>93</sup> Like equipment investigation visits by Hancock’s predecessors, Murdoch and Scherger, Hancock’s team itinerary included France, Britain and the United States. Between 16 June and 12 August 1963, they conducted visits to major manufacturers of



Whitehead

**Above**  
Hancock delivers the final briefing. A media shot taken before the team departed for the US.

Rear L-R: WGCDR L.G. A. Marshal, Mr C. Douglas, GPCAPT C.F. Read

Front L-R: SQNLDR L. Brownley, SQNLDR E. Whitehead, AIRCDRE G.D. Marshall, WGCDR J.A. Robb.

bomber and reconnaissance aircraft and evaluated five candidates: the French Dassault Mirage IV, the British BAC TSR2, and three American options: the McDonnell F-4C Phantom, the North American RA5C Vigilante, and the General Dynamics TFX.

Hancock based his riding instructions on the Defence Committee’s February 1963 strategic appreciation. The appreciation noted that to ‘make an effective and sustained contribution to South-East Asian defence an aircraft is required to replace the Canberras, two squadrons of which have been nominated for the SEATO force which is required to combat Chinese involvement in limited war in South-East Asia.’ It went on to address what it called the ‘Indonesian problem’, noting that the RAAF must have the capability of ‘attacking an airfield such as Morotai from a major Australian airfield such as Darwin or Wewak. Preferably, it should also have the capacity of reaching the vital target complex around Djakarta from the closest Australian based airfield which is Learmonth’. The assessment gave rise to the specification that the bomber should have a





Whitehead

**Below**

Hancock team visit to Gneral Dynamics  
L-R: USAF Escort Officer, L. Brownley, G. Marshall, J. Robb,  
L. Marshall, C. Douglas, E. Whitehead, V. Hancock, J. Lush (Air  
Attaché) , C. Read.

range of 1800 nm, including approximately 300 nm at very low level, could descend into and traverse mountainous territory in poor visibility, and locate, identify and attack targets under such conditions. Ideally, range should be of the order of 2200 nm, which ‘would permit attacks against targets as far afield as Kunming in South China or Djakarta in Indonesia.’<sup>94</sup>

In the Annex to his report, Hancock quoted Minister for Defence, Townley, who had redefined the bomber role as:

To attack enemy targets by day and by night with air to surface missiles, or high explosive bombs. It must also have a capability for photographic, radar and electronic reconnaissance, and be able to accomplish electronic countermeasures missions ... Although its primary and secondary roles are the delivery of conventional weapons and reconnaissance, the aircraft should have the capability of delivering special stores.<sup>95</sup>

‘Special stores’ was a euphemism for nuclear weapons. Clearly, Townley and the RAAF were intent on keeping the nuclear weapons option open, something Hancock had to bear in mind.

According to Squadron Leader Ted Whitehead, the team thought the Mirage IV unsuitable because of its poor hot weather take-off performance. The visit to BAC was notable in that they saw the TSR2 and, while it looked suitable, they had a meeting with

‘... about 50 people, all the specialists on the TSR2 and there was us eight being listened to rather than [them] passing on any information.’<sup>96</sup> BAC executives seemed only interested in seeking clues on the Australian position. The TFX was a wooden mock-up only but the Americans were keen to answer questions and sell their product. Hancock also went off to Boeing to look at KC-135 air-refuelling tankers that would potentially complete any new strike package.

Hancock’s report rejected the Mirage IV and F-4C as not meeting the required specifications in range, low-level performance or reconnaissance capability. The Mirage at A£108m was also considered far too expensive. Although it looked good on paper, the TSR2 was the most expensive of all at a quoted price of A£122m for 24 aircraft. The team went on to assess the TFX as ‘definitely superior to the TSR2’ and as ‘the ideal choice for the RAAF, ignoring other aspects [particularly the projected in-service date of 1970].’<sup>97</sup> Yet after concluding that both the TFX and TSR2 were superior on paper, they recommended the Government purchase 36 North American RA-5C Vigilante aircraft as it was ‘the quickest and most effective means of providing the RAAF with a strike/reconnaissance force.’ The estimated cost was A£88m and the finding was subsequently agreed by the Minister for Air, David Fairbairn, on 24 August 1963.<sup>98</sup>

Hancock’s recommendation was based not so much on performance as set by the ASR, but by availability and delivery schedule. It appears Hancock was driven by the political imperative to get a suitable bomber into the RAAF inventory as soon as possible. The RA-5C was already in service with the USN carrier fleet and could be in RAAF service by December 1966, at least two years earlier than either of the other two options. It would therefore be ‘the quickest and most effective means of providing the RAAF with a strike/reconnaissance force,’ a consideration Hancock thought was the Government’s primary intention.<sup>99</sup> According to Hancock, he:

... wrote a report which outlined the limitations of all these aircraft and recommending that we should go for the Vigilante. I was less than honest when I did this and I’ve come out and said this in my oral record ... It was a lousy report, I thought. I didn’t deal with the situation adequately. What I did point out [was] that nothing really offered us a solution to our problem except the F111 and that may be years away.<sup>100</sup>

He went on to suggest that the F-111 would not be available before 1970, and for his troubles, was ‘sent to Coventry’ and ‘was completely bypassed – one of the sourest times of my life. At no stage did I have any input into the decision about the TFX.’ In his memoirs published under the title *Challenge* many years later, he never once mentioned the F-111 saga, no doubt disappointed over the whole episode.<sup>101</sup>

The evidence gives credence to the idea that the Government wanted an answer to its critics, not an immediate solution to Australia’s bomber capability. The recommended candidate, the North American RA-5C Vigilante, had been developed from the A3J design which had first flown in August 1958. According to the popular aviation press at the time, it ‘combines in one airframe a remarkable range of mission capabilities. [It is a] carrier-based “delivery system” for sub- or supersonic attack with nuclear or conventional weapons in all weather and at low or high altitudes.’<sup>102</sup> Australia was interested in the RA-5C dual-role version, which was configured for both reconnaissance and attack. The aircraft was capable of Mach 2 and had a range of around 2000 nm (3700 km). However, the mission profile envisaged by the USN was not what the RAAF envisaged. The Navy intended a carrier launch in the war zone, a climb to 40 000 ft, a supersonic run into the target (nominally an enemy fleet unit), the release of one nuclear weapon at around 50 000 ft, and return, on a round trip of under 700 nm (1300 km).<sup>103</sup> Australia needed a low-level penetrator, carrying a conventional bombload at an unrefuelled radius of action of over 1000 nm (1850 km). The Vigilante was just unsuitable in almost every respect.





Whitehead

**Above**

Sir Valston Hancock being congratulated by Captain James Mayo, USN, Commander Heavy Attack Wing One, after he completed a flight in an A-5 Vigilante with pilot Lieutenant Bert Collins, USN. The flight was at NAS Sanford, Florida.

**Opposite**

Prime Minister Robert Menzies inspecting RAAF airmen in the Far East. Menzies was instrumental in ordering the F-111.

The Hancock Report was presented to Cabinet in September 1963 after consideration and agreement by both the Air Board and Minister for Air. But Cabinet did not like the recommendation. ‘Quick’ and ‘substantially meeting the ASR’ was not what they were after. They wanted a forward-looking proposal to blunt the Opposition’s barbs, particularly as a Federal Election was approaching. A stopgap loan of bombers would suffice to quell Opposition noise in the interim. The Australian aviation media was agitating too. The influential aviation magazine *Aircraft* ran an editorial in its September 1963 edition entitled ‘We Need a Bomber But Timing is Vital’,

pointing out that getting a solution quickly might not be the right answer.<sup>104</sup>

Hancock’s choice of the Vigilante fell down on three factors: range, strike and reconnaissance roles, and use of extant airfields and facilities. Cabinet noted: ‘It is vulnerable to missiles, is hard on runways and not easy to deploy’ and ‘the raison d’être of the TSR2 and the TFX is that they are designed to avoid radar detection by low-level approach to the target. This is a basic revolution in air warfare.’ As to performance, ‘the RA-5C does not appear to look to the future enough.’<sup>105</sup> But perhaps the clincher was that a reasonable budget spread was needed, even if it meant spending on an interim capability while Australia waited. Cabinet further critiqued the Vigilante, particularly on its performance, maintenance and running costs, and noted that it had not been chosen by the USAF. The aircraft was the USN’s forward-deployed delivery platform for theatre nuclear war, not the tactical strike aircraft Australia needed.

Cabinet referred the matter back through the Minister for Air, David Fairbairn, for further consideration by Townley. Townley took up the reins proposing a direct approach to the Americans that might offer both the TFX and an interim aircraft in one deal. He did not mention the British or the TSR2. Menzies wanted a quick answer as on 15 October, he had called an election that was just several weeks hence. He was running on a platform of defence and foreign policy issues but was under pressure from the opposition Labor Party who were calling for action against growing Indonesian rhetoric over Malaysia.<sup>106</sup> Labor Leader Arthur Calwell had gone as far as reminding the Government that ‘Indonesia could bomb the whole of Australia’ forcing the Joint Intelligence Committee to respond hurriedly from open sources that: ‘... it could be calculated that medium jet bombers based on Biak or Kupang could reach Adelaide, Rockhampton and Western NSW, but not Brisbane, Sydney or Melbourne and most adjoining areas of Southern and Eastern NSW



RAAF Museum

and most of Victoria.’<sup>107</sup> This did not ease matters—Menzies was after a quick fix to silence his critics.

**Townley’s Mission**

Cabinet agreed with Townley’s proposal to urgently discuss options with the Americans and he was hastily dispatched to the US for discussions with McNamara.<sup>108</sup> On 20 October (US time) he was able to cable Menzies excitedly with good news. His Top Secret Immediate cable in part read:

Discussions with McNamara have produced an extremely attractive proposal reducing cost to us of TFX (now called F 111A) by some fifty million dollars, with earlier delivery and fringe benefits ...

The offer is open for thirty days and I doubt if it will be repeated ... Should an interim aircraft be needed, there is also a very generous proposal.<sup>109</sup>

That ‘attractive’ proposal was for 18 F-111As and six RF-111As, available from November 1969. Included in the deal would be the necessary reconnaissance equipment, one year’s supply of spares, and ground handling and training equipment.<sup>110</sup> The US was also prepared to lend up to 24 B-47E Stratojets at no cost other than operating expenses, and, to seal the deal, was prepared to offer training (on a cost reimbursable basis) and extremely good payment terms. The B-47s would be retrofitted for conventional weapons and would remain interoperable with US forces based in the Guam. Best of all, the TFX aircraft would last



Defence PR

**Above**

Athol Townley, Minister for Defence, the man who bought the deal.

well into the 1970s without becoming obsolete. It was a deal too good to be true!

The secret was leaked to the *Melbourne Age* newspaper. Their page one headline of 17 October 1963 read: ‘Deal with US on Aircraft possible’, and went on to explain the purpose of the Townley mission.<sup>111</sup> Townley was forewarned of the leak and wasted little time signing a Memorandum of Understanding (MOU) with McNamara on 19 October which offered a cooling-off period of just 30 days to contract. It was enough time to get Cabinet approval and announce the deal well before the 30 November election day. The offer was accepted immediately as Menzies chose not to wait the 30 days. He called a meeting of Cabinet on 22 November where they agreed that the TFX was the most suitable option, the costs were ‘advantageous’ and that it was good for joint Australia-US relations.<sup>112</sup> The arrangements also included the

purchase of three frigates for the Navy and the establishment of a USN communications station on Australia’s North West Cape in Western Australia.<sup>113</sup>

In Cabinet’s estimation, the TFX was the ‘ideal’ choice and, more importantly, it could be ‘sold’ to the Australian public.<sup>114</sup> The offer involved 24 aircraft out of an expected production run of over 1500 and at an approximate cost of US\$124.5m (A£56m) was a bargain.<sup>115</sup> The delivery of 24 interim B-47s would occur between January and June 1964 and cost an additional US\$24.8m. Australia would only be required to pay US\$20m per year commencing in calendar year 1963, terms very favourable to the Treasury.<sup>116</sup> The Air Board, however, was not consulted and had to urgently discuss the deal before the expected media questions. All it had was a copy of Townley’s cable to work on and the TFX Annex of Hancock’s report.<sup>117</sup>

Although it seemed the US gave Australia favourable terms, the Kennedy Administration had good reasons to support the Australian Liberal Government in any way it could. Much of the Labor policy on defence ran counter to US intent in the Asia-Pacific region, with, amongst other things, Calwell and Labor factional leader, Jim Cairns, calling for a nuclear-free southern hemisphere. Also under threat was the US Naval Communications Station at North West Cape, near Exmouth in Western Australia, vital for USN operations in the Indian Ocean. The idea of giving Australia some preferential treatment was already on Kennedy’s mind before the F-111 order. Kennedy had written a confidential memo to Secretary McNamara in May 1963 urging that:

It is essential that we make every effort to prosecute the program of selling U.S. equipment to allies such as Australia. Not only will this decrease the net outflow of gold from this country, but it also ties in our military aid to foreign policy.<sup>118</sup>

Kennedy and McNamara could gain too, with Congress well into its investigation into the TFX contract. How better to win Congressional support

than from a close ally showing such faith in the TFX concept? In his last speech delivered the morning of his assassination, Kennedy addressed the Fort Worth Chamber of Commerce, stating: ‘The Government of Australia, by purchasing \$125 million of TFX planes before they are even off the drawing boards, has already testified to the merit of this plane, and at the same time, is confident in the ability of Fort Worth to meet its schedule.’<sup>119</sup> Preaching to the converted perhaps, but also sending a message to Congress.

From the moment of the Cabinet decision, things happened quickly. When debating the Appropriation Bill on 22 October in the House, Menzies made no mention of Townley’s cable and again came under attack from Arthur Calwell about the lack of deterrent capability. Menzies cunningly waited for Cabinet assent and then dropped a Parliamentary bombshell two days later when he announced the F-111A deal, with deliveries from 1967.<sup>120</sup> While Menzies went on to win the election of November 1963 with an increased majority, the win did not quell the complaints from Calwell and the Opposition. They now called for a reconsideration of the TSR2 and the cancellation of the F-111 on the grounds the decision was made more as a political stunt, than for serious strategic reasons. The Australian Labor Party would have to wait until they took Government before they would have the opportunity to make any such reconsideration, and that would be 10 years later when the F-111s finally arrived.



Notes

1

Royal Australian Air Force, *Australian Air War Effort*, 10th Edition, 31 August 1945, pp. 16 and 110. The total RAAF strength 1939–1945 was 215 628.

2

National Archives of Australia (NAA): A11093, 452/A96 Part 1; and Michael V. Nelmes, *Tocumwal to Tarakan: Australians and the Consolidated B-24 Liberator*, Banner Books, Belconnen, 1994. The RAAF ordered 287 Liberators. By August 1946, there were 246 in service.

3

The RAAF in August 1945 comprised 173 622 personnel serving in 570 units, of which 75 were operational flying squadrons. NAA: A1196, 36/501/589, 29 August 1945. Also Alan Stephens, *The Australian Centenary History of Defence – Volume II – The Royal Australian Air Force*, Oxford University Press, South Melbourne, 2001, pp. 173–179; and Alan Stephens, *Going Solo: The Royal Australian Air Force, 1946–1971*, Australian Government Publishing Service, Canberra, 1995, p. 10.

4

NAA: A5954, Box 1842; and Air Board Minute 921, 18 May 1948.

5

Stephens, *Going Solo*, p. 34. With respect to bomber squadrons, the 16-squadron Air Force provided for three operational units. These were Nos 1, 2 and 6 Squadrons.

6

Air Board Agendum 7493, 6 September 1946; and Air Board Minute 908, 24 March 1948.

7

The world’s first air force, the RAF, was created in 1918 in part for the independent bombardment role it offered and in part for efficiency reasons. Malcolm Cooper, *The Birth of Independent Air Power: British Policy in the First World War*, Allen & Unwin, London, 1986.

8

Office of Air Force History (OAFH), Air Board Agendum 8370, 18 September 1947.

9

Lawrence James Wackett, *Aircraft Pioneer: An Autobiography*, Angus and Robertson, Sydney, 1972, p. 170. Wackett’s Commonwealth Aircraft Corporation won the contract to build the Lincoln engines.

10

J.Y. Mann, ‘Aircraft Fatigue – With particular emphasis on Australian Operations and Research’, DSTO Report R-002-947, Aeronautical Research Laboratories, Melbourne, April 1983, pp. 20–21.

11

NAA: A4638, 27/28 June 1950, Cabinet Submissions D.69 and D.50A; Peter Dennis and Jeffrey Grey, *Emergency and Confrontation: Australian Military Operations in Malaya and Borneo 1950–1966*, Allen & Unwin, St Leonards, 1996, p. 24; Royal Air Force, AP3410, *The Malayan Emergency 1948–1960*, Ministry of Defence, London, 1970, p. 74; and Air Commodore Mark Lax, ‘The War of the Running Dogs: The Malayan Emergency’, in Wing Commander Keith Brent (ed.), *Air Expeditionary Operations from World War II until Today – Proceedings of the 2008 RAAF History Conference*, Air Power Development Centre, Tuggeranong, ACT, 2009, pp. 31–42.

12

The Lincoln cruise speed was 145 kts (270 kph) whereas, for example, the US piston-engined B-36 Peacemaker of the same era cruised at 200 kts (370 kph). Mike Garbett and Brian Goulding, *Lincoln at War 1944–1966*, Ian Allen Ltd, London, 1979, p. 175; and Marcelle Size Knaack, *Post-World War II Bombers 1945–1973*, USAF Office of Air Force History, Washington, DC, 1988, p. 55.

13

OAFH, Air Board Agendum 12910, 20 April 1961; Garbett and Goulding, *Lincoln at War 1944–1966*, p. 161; and Stewart Wilson, *Lincoln, Canberra & F-111 in Australian Service*, Aerospace Publications, Weston Creek, ACT, 1989, p. 74.

14

NAA: A4940, C293, 9 January 1950 and Cabinet Agendum 1.E, 1/2 August 1950; and Air Board Agendum 10334, 20 November 1950, ‘Procurement of two “Canberra” Turbo-Jet Aircraft from the United Kingdom’, 20 November 1950.

15

NAA: A705, 9/91/363 Parts 1 and 2.

16

ibid. Also Stephens, *Going Solo*, p. 257; and Jeffrey Grey, *A Military History of Australia*, Cambridge University Press, Melbourne, 1990, p. 216.

17

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 6, 20 April 1955, p. 50.

18

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 8, 29 September 1955, p. 1137.

19

Francis K. Mason, *The British Bomber since 1914*, Putnam, London, 1994, p. 371. Stewart Wilson, *Lincoln, Canberra & F-111 in Australian Service*, p. 97, gives a slightly longer range with the same bombload.

20

NAA: A5619, C40 Part 1, September 1963.

21

OAFH, Air Board Agendum 12511, 30 June 1955.

22

NAA: A1196, 1/501/678.

23

ibid.

24

Among the best analyses of the issue is Luke Thomas Auton, “A Sort of Middle of the Road Policy”: Forward Defence, Alliance Politics and the Australian Nuclear Weapons Option, 1953–1973’, unpublished PhD Thesis, University of New South Wales, Australian Defence Force Academy, Canberra, 2008. See also Wayne Reynolds, *Australia’s Bid for the Atomic Bomb*, Melbourne University Press, Carlton, 2000; Wayne Reynolds, ‘The Wars that were Planned: Australia’s Forward Defence Posture in Asia and the Role of Tactical Nuclear Weapons, 1945–1967’, in *Australian Journal of International Affairs*, vol. 53, iss. 3, 1999; Stephens, *Going Solo*, pp. 365–369; Alan Stephens, *Power Plus Attitude: Ideas, Strategy and Doctrine in the Royal Australian Air Force 1921–1991*, Australian Government Publishing Service, Canberra, 1992, pp. 147–149; and Jim Walsh, ‘Surprise Down Under: The Secret History of Australia’s Nuclear Ambitions’, in *The Nonproliferation Review*, vol. 5, no. 1, Fall 1997.

25

NAA: A1945, 186/5/3, 12 September 1956.

26

NAA: A7942, N78 Part 1, meetings held on 8 and 12 October, and 2 November 1956.

27

ibid.

28

NAA: A6456, R021/001 Part 76; and Stephens, *Going Solo*, p. 367. The smallest weapon weighed over 4000 lb (1500 kg) and was over four metres long.

29

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 16, 19 September 1957, p. 798.

30

Walsh claims Australia’s attempts to get the bomb came in two phases: first, the attempted procurement phase (1956–1963) and, second, the indigenous capability phase (1964–1972). Neither phase was successful. Walsh, ‘Surprise Down Under: The Secret History of Australia’s Nuclear Ambitions’, p. 1.

31

NAA: A7942, N78 Part 1, 1 April 1958.

32

ibid., note to the Minister, 27 September 1957.

33

ibid., Scherger, note to File, 16 October 1958; and NAA: A1945 6/5/10, 13 November 1958.

34

Stephens, *Going Solo*, p. 367; Reynolds, *Australia’s Bid for the Atomic Bomb*, p. 217.

35

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 37, 15 November 1962, p. 2535.

36

NAA: A705, 9/91/363 Parts 1 and 2. The British V-bombers were the Vulcan, the Victor and the Valliant.

37

NAA: MP1472/41; and A1196, 1/501/717. Conveniently, A.V. Roe & Co Ltd had prepared a paper ‘A Comparison of Bomber Performance’ which compared the Vulcan, Canberra and Stratojet. Naturally, the Vulcan (their product) came out on top.

38

NAA: A1196, 1/501/717. Also Stewart Wilson, *Vulcan, Boeing B-47 & B-52*, Aerospace Publications, Fyshwick, ACT, 1997, p. 38.

39

The National Archives, UK (formerly known as the Public Record Office): Prem 11/1206.

40

‘Australia’s Need to Spend Less’, in *Financial Times*, 9 August 1956.

41

Air Vice-Marshal Hancock, quoted in ‘RAAF Seeks Successor to Canberra’, in *The Sydney Morning Herald*, 27 April 1960, p. 21. Frederick Osborne, Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 26, 31 March 1960, p. 810.

42

NAA: A5619, C40 Part 1, ‘Purchase of F111 aircraft for RAAF’. References Cabinet Submission 322 of July 1962.

43

OAFH, Air Board Agendum 12930, 8 October 1962.

44

ibid., notes to Cabinet Submission 884.

45

National Library of Australia: *The Sydney Morning Herald*, 5 October 1962, 12 October 1962, and 19 October 1962.

46

National Library of Australia: *The Sydney Morning Herald*, 29–30 January 1963; *West Australian*, 31 January 1963; and *Adelaide Advertiser*, 29 January 1963.

47

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 37, 25 October 1962, p. 2003; and vol. 37, 5 and 6 December 1962, p. 3026. Fairbairn referred to *Jane’s All the World’s Aircraft* as an open and authoritative source.

48

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 38, 22 May 1963, p. 1671. From FY 1963–64 the Defence vote would increase by £41m per year over 5 years.

49

The Hon. David Fairbairn, ‘Royal Australian Air Force: RAAF Rearmament’, in *RAF Quarterly*, vol. 3, no. 4, Winter 1963, p. 300.

50

‘Flight Over Sverdlovsk’, in *Time*, 16 May 1960.

51

NAA: A1209, 1960/517.

52

Air Marshal David Evans, interview, 4 December 2008.

53

NAA: A4940, C3852 Attachment, 18 April 1969.

54

Hanno Weisbrod, ‘Australia’s Decision to Buy the F-111’, in *The Australian Quarterly*, vol. 41, no. 2, June 1969, pp. 7–27.

55

‘TSR2’, in *Air Pictorial*, vol. 27, no. 5, May 1965; and ‘TSR2’, Parts 1–4, in *Air Pictorial*, vol. 40, nos 9–12, September–December 1978 cover the complete functional design.

56

Tony Butler, *British Secret Projects: Jet bombers Since 1949*, Midland Publishing, Hinckley, 2003, p. 112.

57

Volumes have been written about the TSR2 and its demise. The best sources are Derek Wood, *Project Cancelled: A searching criticism of the abandonment of Britain’s advanced aircraft projects*, Macdonald and Jane’s, London, 1975, pp. 149–181; Roland Beamont, *Phoenix into Ashes*, William Kimber, London, 1968; and Stephen Hastings, *The Murder of the TSR2*, Macdonald, London, 1966.

58

Air Historical Branch (RAF): Air 2 Item 15302; Harry Rayner, *Scherger: A Biography of Air Chief Marshal Sir Frederick Scherger*, Australian War Memorial, Canberra, 1984, p. 156; Hastings, *The Murder of the TSR2*, p. 89–91; and Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, 10 April 1963, p. 551. Similar visits with TSR2 presentations were made to New Zealand and Canada.

59

Air Historical Branch (RAF): Air 8 Item 2398, 23 October 1963. Delivery would be 12 aircraft in 1968 and the rest in 1969.

60

Australian War Memorial, S01657, interview transcript, p. 64; and Air 8 Item 2398, 11 November 1963.

61

General Sir William Jackson and Field Marshal Lord Bramall, *The Chiefs: The Story of the United Kingdom Chiefs of Staff*, Brassey’s (UK), London, 1992, p. 365; Hastings,



*The Murder of the TSR2*, pp. 91–92; and Wood, *Project Cancelled*, pp. 174–177.

62 Philip Ziegler, *Mountbatten*, Harper & Row, New York, 1985, pp. 553.

63 *ibid.*, pp. 587–588. Barnes Wallis, inventor of the Dambuster’s ‘bouncing bomb’, was also working on a variable geometry aircraft he called the Swallow.

64 Hastings, *The Murder of the TSR2*, pp. 90–91. Hastings was not an impartial observer of the project—he was a Conservative Member of Parliament and former director of Handley-Page Ltd, a forerunner of BAC (the manufacturer of the TSR2).

65 The National Archives, UK: CAB148/19/11.

66 Harold Wilson, *The Labour Government 1964–1970: A Personal Record*, Weidenfeld & Nicholson, London, 1971, p. 39; and Beamont, *Phoenix into Ashes*, p. 153.

67 *ibid.* These included undercarriage, engines and fuel flow problems.

68 Rayner, *Scherger*, p. 160; and Phil Strickland, ‘Politics over Strategy – Australia’s Rejection of TSR2’, in *TSR2 With Hindsight*, RAF Historical Society, UK, 1998, p. 43.

69 The National Archives, UK: CAB 148/19/14; Strickland, ‘Politics over Strategy’, pp. 65–66; Bill Gunston, ‘TSR.2: What went Wrong?’, in *Aeroplane Monthly*, September 1973, pp. 219–220; and editorial, ‘TSR-2’, in *Air Pictorial*, vol. 27, no. 5, May 1965, p. 143 offer extensive clarification.

70 Speaking were Air Vice-Marshal Nigel Baldwin, Marshal of the RAF Sir Michael Beetham and Air Marshal Sir Freddie Sowrey. *RAF Historical Society Journal*, no. 31, UK, 2004, pp. 9–10.

71 Australian War Memorial, S01657, Hancock interview transcript, p. 66.

72 NAA: A6706, 2; and Air Historical Branch (RAF): Air 8 Item 2398.

73 NAA: A6706, 2; and The National Archives, UK: Air 8 Items 2396, 2397 and 2398; and Air 19 1074 *passim*. Editorial, ‘Buy British ...?’, in *Air Pictorial*, vol. 25, no. 12, December 1963, p. 381; ‘Australia to buy American bomber: Setback to British TSR2 hopes’, in *The Times*, 25 October 1963; and ‘TSR2 Puzzle’, in *The Daily Telegraph*, 29 October 1963.

74 The Century Series fighters were the F-100 Super Sabre, F-101 Voodoo, F-102 Delta Dagger, F-104 Starfighter, F-105 Thunderchief and F-106 Delta Dart. The Thunderchief was the only air-to-ground nuclear weapon capable fighter, but was extremely limited in range. The missing F-103, F-107, F-108, and F-109 never went past the prototype stage, the F-110 was renamed the F-4 Phantom and the F-111 was never really a fighter. The only other Century Series ‘fighter’ produced was the F-117 Nighthawk, but it was not developed until much later.

75 Bernard O. Heath, ‘Problems of Variable Geometry Aircraft’, in *Flight International*, 12 October 1967, pp. 617–619; and Richard P. Hallion, ‘The Variable Sweep Wing: Application by the USAF’, in *Variable Sweep Wings: From Theory to Practice*, Air Force Historical Foundation, 27 March 1981.

76 National Library of Australia: U.S. Congress, Senate, Eighty-eighth Congress, first session; Committee on Government Operations, *TFX Contract Investigation*, Government Printing Office, Washington, DC, 1963, vol. 3, pp. 738 and 740.

77 Robert J. Art, *The TFX Decision: McNamara and the Military*, Little, Brown and Company, Boston, 1968, pp. 15–16.

78 Ian Gabriel, Boeing F-111 Program Manager, interview, 2 June 2009; Bill Gunston, *Modern Combat Aircraft 2: F-111 General Dynamics*, Ian Allan, London, 1978, p. 12; and Art, *The TFX Decision*, p. 25.

79 The original contenders were: Boeing, North American Aviation, General Dynamics, Lockheed, Republic and McDonnell. U.S. Congress, Senate, Eighty-eighth Congress, first session; Committee on Government Operations, *TFX Contract Investigation*, 1963, p. 489.

80 The USAF Source Selection Board process is far too complex to explain here. Readers are advised to read Art, *The TFX Decision*; and Robert F. Coulam, *Illusions of Choice: The F-111 and the Problem of Acquisition Reform*, Princeton University Press, Princeton, NJ, 1977.

81 U.S. Congress, Senate, Eighty-eighth Congress, first session; Committee on Government Operations, *TFX Contract Investigation*, 1963, pp. 119 and 208–209. Total program costs in March 1963 as adjusted by the USAF were GD – US\$7.083b and Boeing – US\$6.983b.

82 Larry Booda, ‘USAF and Navy Unable to Agree on Joint Tactical Fighter Project’, in *Aviation Week & Space Technology*, vol. 75, no. 8, 21 August 1961; and U.S. Congress, Senate, Eighty-eighth Congress, first session; Committee on Government Operations, *TFX Contract Investigation*, 1963, USN testimony.

83 Art, *The TFX Decision*, p. 77.

84 The reasons McNamara overturned the findings of the Source Selection Board are very complex and beyond the scope of this book. Interested readers are advised to read Art, *The TFX Decision*, Part V – Performance, Cost and Commonality; and U.S. Congress, Senate, Eighty-eighth Congress, first session; Committee on Government Operations, *TFX Contract Investigation*, 1963. See also Kurt H. Miska, *General Dynamics F-111A to F & FB-111A*, Hylton Lacy Publishers, Windsor, 1973, p. 5. Australia had no say in the evaluations.

85 Richard Austin Smith, ‘The \$7-Billion Contract That Changed the Rules’, in *Fortune*, March and April 1963; and George C. Wilson, ‘TFX Probe to Focus on Possible Conflict in Gilpatric, Korth Roles’, in *Aviation Week & Space Technology*, vol. 79, no. 11, 9 September 1963. There are many other examples such as: ‘Probers of TFX Contract Criticised by McNamara’, in *Air Force Times*, vol. XXIII, no. 33, 20 March 1963; Larry Booda, ‘New Delay Raises Doubts on TFX Future’, in *Aviation Week & Space Technology*, vol. 77, no. 2, 9 July 1962; Larry Booda, ‘Rift May Affect TFX Role, Configuration’, in *Aviation Week & Space Technology*, vol. 79, no. 11, 9 September 1963; ‘Subcontractors May Split Half of TFX Melon’, in *Air Force Times*, vol. XXIII, no. 37, 17 April 1963; Claude Witze, ‘Where does the hot line lead?’, in *Air Force & Space Digest*, vol. 46, no. 9, September 1963; and Claude Witze, ‘If you can’t stand the heat ...’, in *Air Force & Space Digest*, vol. 46, no. 6, June 1963.

86 This was the first of two lengthy Congressional investigations, one in 1963 and one in 1970.

87 Hinted at in John Wegg, *General Dynamics Aircraft and their Predecessors*, Putnam Aeronautical Books, London, 1990, p. 233.

88 Richard Austin Smith, ‘How a Great Corporation got out of Control’, Part II, in *Fortune*, vol. 65, February 1962, pp. 120–122 and 178–188.

89 ‘Takeoff for the F-111’, in *Time*, 19 May 1967, p. 65. The US\$214m loss included that of the troubled Convair airline division. General Dynamics had also secured further US Government orders, mainly from naval ship sales and in the rocket (Atlas & Centaur) and missile (Poseidon, Standard, Terrier and Tartar) divisions.

90 ‘McNamara on TFX: The US Secretary of Defense Defends Himself’, in *Flight International*, vol. 83, no. 2823, 18 April 1963.

91 U.S. Congress, Senate, Ninety-first Congress, second session; Committee on Government Operations, *TFX Contract Investigation (Second Series)*, Report No. 91-1496, Government Printing Office, Washington, DC, 1970, Part 1, p. 51.

92 U.S. Congress, Senate, Eighty-eighth Congress, first session; Committee on Government Operations, *TFX Contract Investigation*, 1963, Part 10, p. 2740 ends in recess.

93 As well as Hancock, the team included: Air Commodore Geoff Marshall (Controller of Technical Plans), Group Captain Charles Read (Director of Operational Requirements), Wing Commander Lewis Marshall (Technical Staff Officer (Armament)), Wing Commander John Robb (Deputy Director Telecommunications), Squadron Leader Lionel Brownley (Equipment Staff Officer), Squadron Leader Ted Whitehead (Technical Staff Officer (Engines)) and Mr C. Douglas (Assistant Secretary, Department of Air).

94 OAFH, Air Board Agendum 13017, 23 August 1963, Appendix C.

95 *ibid.*, folio 27.

96 Air Commodore Ted Whitehead, interview, 11 July 2008.

97 Hancock Report, paragraph 119.

98 *ibid.*, paragraph 5; and Air Board Agendum 13017.

99 NAA: A5619, C40 Part 1, Cabinet Submission 884, 16 September 1963; and NAA: A4940, C3852.

100 Australian War Memorial, S01657, Hancock interview transcript, pp. 65–66.

101 Sir Valston Hancock, *Challenge*, Access Press, Perth, 1990.

102 ‘Vigorous Vigilante: A Remarkable Range of Mission Capabilities’, in *RAF Flying Review*, vol. XV, no. 5, February 1969.

103 ‘Versatile Vigilante’, in *RAF Flying Review*, vol. XVII, no. 11, 1962, pp. 33–35; John W.R. Taylor (ed.), *Jane’s All the World’s Aircraft, 1964–65*, Sampson Low, Marston & Company Ltd, London, 1964, pp. 266–267, gives the specifications, and Norman Friedman, *Carrier Air Power*, Conway Maritime Press, Greenwich, 1981, p. 115, gives the mission profile.

104 ‘We Need a Bomber But Timing is Vital’, in *Aircraft*, vol. 42, no. 12, September 1963, p. 19.

105 NAA: A5619, C40 Part 1, Cabinet Decision 1022, 16 September 1963.

106 T.B. Millar, *Australia’s Defence*, Melbourne University Press, Carlton, 1965, p. 5.

107 *The Age*, 21 October 1963, p. 3. Calwell was quoted as saying ‘Indonesia could wipe out any one of our cities and the whole of our air strength could not save it’. NAA: A1945, 146/1/16, 22 October 1963.

108 NAA: A4940, C3852, Cabinet Minute 1057, 7 October 1963.

109 NAA: A5619, C40 Part 1, Department of External Affairs Cablegram sent 20 October 1963.

110 OAFH, Advice from the Minister for Defence on proposals for Purchase of TFX Aircraft and loan of B47E Aircraft from the United States of America, Special Air Board Meeting, Record of Proceedings 1963, 22 October 1963, p. 111.

111 *The Age*, 17 October 1963, p. 1; and ‘Gap to close in air strength’, in *The Age*, 18 October 1963, p. 2.

112 NAA: 4940, C3852, Cabinet Minute 1104 (FAD), 22 October 1963.

113 *ibid.*

114 *ibid.*

115 The intended production run of F-111s was 876 in October 1961, 1726 in July 1962, 1923 in May 1963 and 2411 by May 1964. When, in 1968, the USN and UK cancelled their

## FROM CONTROVERSY TO CUTTING EDGE

aircraft orders, production fell by 755. This caused a jump in unit cost.

- 116 NAA: A5619, C40 Part 2, 19 October 1963.
- 117 OAFH, Special Air Board Meeting, 22 October 1963.
- 118 National Security Action Memorandum No. 242, 9 May 1963, at <http://www.jfklibrary.org/Search.htm?q=security+action+memorandum+number+242&site>, accessed 8 January 2010.
- 119 'Remarks at the Breakfast of the Fort Worth Chamber of Commerce, November 22nd, 1963', at <http://www.jfklibrary.org/Historical+Resources/Archives/Reference+Desk/Speeches>, accessed 12 March 2009
- 120 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 40, 24 October 1963, pp. 2250–2251; 'That F111A (TFX) Decision ..', in *Aircraft*, vol. 43, no. 2, November 1963, p. 40; and 'Australia will buy two TFX Squadrons', in *The Age*, 25 October 1963, p. 1.

# 3. ACQUISITION (PART I)

## 1963–1968

*The F-111 acquisition and bringing it into service breached a very profound transition in Australia's strategic circumstances. ... The F-111 was very central to the acceptance that Australia could build itself a self-reliant defence posture ...*

Professor Hugh White<sup>1</sup>

Although the Menzies Government had made the decision to acquire the F-111, getting the aircraft into service would not be as simple. The broad strategic outlook was worrying given the communist trouble in Indo-China, the growing agitation of a belligerent Indonesia, and a fear of Chinese intentions in the Pacific and Indian Oceans. Britain's long-term place in South-East Asia was also becoming doubtful. The RAAF, too, had its own problems, stretched to get on top of the technical and training challenges the F-111 would bring. This chapter explains the early problems faced by the RAAF, the relationship between the RAAF and the USAF in meeting F-111 program requirements, and how cost increases, schedule delays and technical complexity added to the aircraft's controversial reputation.

### **Politics and the Media**

Menzies' announcement that Australia would buy the F-111, launched a 40-year debate—why did Australia need the F-111 and at what cost? The fact that Menzies had made a decision after a 10-year wait was not so much the point. Australia would finally get an aircraft that, if necessary, could fly unrefuelled to Jakarta, drop bombs and return. Australia could also now boast an independent deterrent, even if it was to take another four years to arrive. The Opposition was suddenly blunted, yet throughout the 1960s and into the 1970s, members of the Labor

Party continued to state their belief that the decision had been made purely for political purposes. After problems later arose with delivery, new Labor Leader, Gough Whitlam, compared the F-111 decision unfavourably with that of 'the Government's long and careful evaluation of the report on the Mirage fighter', stating that 'the [F-111] deal was closed for electoral reasons with which the RAAF had nothing to do'.<sup>2</sup> The issue was to be used as ammunition at every occasion up to aircraft delivery when further comment seemed futile.

In Britain, there was shock and outrage with questions being asked about why TSR2 had been rejected. The London *Daily Telegraph* reported that Britain had offered Australia 25 TSR2 aircraft plus two squadrons of Vulcans on loan until TSR2 could be delivered for the all-up price of £60m Sterling, a better deal than that offered by the Americans.<sup>3</sup> The announcement later generated further accusations in Britain that Australia was partly responsible for the TSR2's demise, as an overseas order would have forced the UK Government's hand not to cancel the program. In Australia and after the initial media euphoria, newspaper articles began to question why Australia had committed to a 'paper' aeroplane and how much it would cost.<sup>4</sup> In the US, a Congressional hearing had already begun into the TFX contract arrangements, casting doubts on the program, but at this early stage the Australian deal was not examined.<sup>5</sup>





RAAF Museum

**Above**  
Gough Whitlam, as Leader of the Opposition, politically was a critic of the aircraft, but privately was a supporter.

**Opposite**  
The massive B-47 Stratojet was intended as an interim while the RAAF awaited the F-111. Three visited Australia in November 1963 and departed wearing RAAF roundels.

A month after the announcement, the *RAAF News* headlined: ‘TFX Named Canberra Replacement’, placed neatly beside an announcement that the first Australian Mirage was about to undertake its first flight.<sup>6</sup> As well as planned new fighters and strike reconnaissance aircraft, by 1964 new transports (Caribous) and helicopters (Iroquois) would begin to enter service. The Royal Australian Air Force was modernising to meet strategic circumstances.

One matter that was not picked up by the media or politicians was the RAAF’s trade-off of numbers (quantity) for technical sophistication (capability),

with cost being the main driver in each case. The bomber fleet had steadily declined numerically from the end of World War II, and with the F-111 purchase was down to just 24 aircraft, six of which were intended to become reconnaissance versions only.<sup>7</sup> While the increase in technological sophistication gave the RAAF a huge improvement in capability, worrying for the Air Staff would be the problem of attrition due to accidents or operational losses, a factor that was to lead to an F-111 attrition buy in the early 1980s, to be examined later.

**An Interim Bomber –  
The B-47E Stratojet for the RAAF**

As the F-111s were at least five years away, one immediate issue was the stopgap bomber capability promised to Townley by McNamara. Part of the ‘good deal’ was the sweetener of an interim force of 24 Boeing B-47E and RB-47E Stratojets, the predecessor of the better known B-52 Stratofortress, to fulfil Australia’s strike and reconnaissance needs during the construction of the F-111s.<sup>8</sup> The need seemed pressing, as in November 1963 Britain had sought Australian support for their forces in Malaysia, support which included Australian bombers.<sup>9</sup> B-47s had first visited Australia in November 1956 during Operation *Handclasp*, a goodwill exercise put on by SAC to demonstrate the aircraft’s transcontinental capability.<sup>10</sup> Although the loan of the 24 aircraft was ‘free’, the RAAF would be asked to pay for operating expenses, spares and reconditioning before return. The B-47 was still in USAF service, but was already obsolescent, having been replaced by the more capable B-52 from the mid-1950s.<sup>11</sup>

Although the Kennedy Administration sought to distance itself from claims of American involvement in Australian politics, the clearest evidence of tacit support for the Liberal Party came soon after the TFX announcement. To cement the TFX purchase and conscious of the pressure the Menzies Government was under with an election imminent, the US Secretary of Defense ordered three B-47s



RAAF Museum

based in Guam to conduct a ‘demonstration’ tour around Australia between 14 and 28 November 1963. Called *Project Australia* by the Americans, the tour ‘coincidentally’ commenced two weeks prior to Australia’s federal election day.<sup>12</sup> The aircraft, together with supporting personnel, were based at Amberley and the visit, led by a USAF Brigadier General, received wide publicity.<sup>13</sup>

While the B-47 option had been briefly considered as part of a previous aircraft evaluation tour undertaken by Air Vice-Marshal Murdoch in 1954, it was not reconsidered by Hancock because as Murdoch had reported, ‘it is too slow, lacks operating height and has insufficient range’. Moreover, the aircraft ‘is being taken out of production in June, 1955’ and at US\$2.5m each, ‘the unit costs were very high’.<sup>14</sup> There were other problems with the B-47. Aircrew and ground crew training would require 18 months in the US and full operational capability would not be achieved until training on the F-111 was due to commence. Accepting the B-47 meant disbanding other formed RAAF units as the need for support manpower was high. Additionally, most airfields

would require lengthening at some cost. Finally, it was assessed that the Canberras could remain relatively effective for at least a further five years, so the B-47s would not be required.

Despite Hancock’s views of the B-47, he could not resist the opportunity to fly the leviathan. When the three aircraft arrived in Australia in November 1963, Hancock elected to fly one to Darwin the next day.<sup>15</sup> He later recalled they took off from Amberley and flew it all the way to Darwin on instruments where he stated that while it performed ‘very well, indeed ... I dismissed the B-47 very quickly. I said it’s no more than a long range Canberra – no damn good to us’.<sup>16</sup>

What Hancock didn’t mention in his memoirs was his rather dangerous, almost fatal, take-off witnessed at Amberley by RAAF and USAF personnel alike. The engines of the Stratojet bombers required water injection during take-off. Each engine had water sprayed into the compressor inlet to cool the air entering the engine, thereby increasing thrust. Without it, the heavy aircraft on a hot day would not have sufficient thrust to get into the air. Wing

Commander David Evans who held the appointment of Operational Requirements – Bomber, and who was due to fly the aircraft, was replaced at the last minute by Hancock. Evans sat on the floor underneath as an observer on the flight, and later explained what transpired:

I was [in the cockpit] getting everything ready for take-off and we got a radio message saying that the Chief of the Air Staff was going to fly it. So I was kicked out of the seat and sat on the floor of the thing, but the water injection was on—I'd put it on—and the instructor pilot was talking to him ... Sir, here is the water injection if you feel down there and so on ... and Hancock switched it off. So we took off without the water injection. We went off the end of the strip and all the Americans watching saw the wing drop and they said, 'It's gone', because they said that's how they lost a lot of B-47s. Dust came up off the end of the strip ... anyhow, we finally got up to Darwin.<sup>17</sup>

Evans went home separately. As well as frightening the Americans, this incident may also have contributed to Hancock's rejecting the aircraft as an interim before the F-111s arrived. After a whirlwind tour including flights to Darwin, Townsville, Pearce, Edinburgh and Avalon, and an air defence exercise over the Sydney area, the aircraft departed for Guam sporting rather large RAAF roundels painted under each nose. They were never seen in Australia again.

Of the 16 operational requirements listed in the specification, the B-47E failed to meet ten.<sup>18</sup> Consequently, the Air Board recommended to the Minister that the B-47 be rejected. Cabinet accepted the submission and on 19 March 1964, Sir Paul Hasluck, Minister for External Affairs, formally wrote to McNamara through the US Ambassador, William Battle, advising him that introduction of the B-47 'poses formidable problems for us' and that 'we are probing this question [of interim aircraft] further'.<sup>19</sup> There the matter ended.

The American reaction to the rejection was not recorded, but the RAAF Air Board did not want the B-47 at the expense of an operational squadron. The

Air Staff then counter-proposed the F-4C and RF-4C Phantom aircraft be leased should a stopgap aircraft be needed. They drew up a strong case for Cabinet to consider, including the use of KC-135 air-to-air refuelling aircraft if required for operations.<sup>20</sup> Perhaps it was a coincidence, but the Australian aviation media had proposed just that solution—the F-4/RF-4 option—only a few months before.<sup>21</sup> Nevertheless, despite Hancock's rejection of the F-4 on range in his report, it was the first mention of the F-4 proposal as an interim bomber, but it too was not taken up at this time. Among other decisions to come out of the Government's consideration of the B-47s were the retention of the Canberra for at least the short term, and expenditure of A£3.653m for works at RAAF Base Amberley and £8m for Wewak in the Territory of Papua and New Guinea in preparation for the F-111's arrival.<sup>22</sup>

**A Quantum Leap**

It was after the signing of the technical agreement in 1964 that the RAAF first became uneasy with the technological leap it was about to make. Although the deal seemed great to the politicians and was trumpeted by the media, the RAAF soon realised that this would be no simple procurement. Squadron Leader Ian Sutherland in the Technical Branch was asked to review the documentation provided after signature on the technical arrangement in 1964. He recalled:

I went through them and could see there was indeed a lot to be done so proceeded to map out what would be known as a project plan these days. With the guidance of Air Vice-Marshal Ernie Hey, I set up a time line, for technical works, project tech personnel postings, drafted a maintenance plan which became an interim working document, providing initial detailed arrangements for the depot level maintenance of the aircraft and all its repairable components, personnel requirements at all levels and conversion training for maintenance musterings.<sup>23</sup>



RAAF Museum

**Above**

The No 3 Aircraft Depot Hangar under construction. It was opened on 20 September 1978.

**Above right**

The No 482 Squadron Hangar under construction. It soon got the nickname the 'Taj' after the Taj Mahal.

The aircraft was a quantum leap ahead of the types the RAAF had operated and it would prove a maintenance and logistics challenge from its inception.<sup>24</sup>

The first problem was the design and construction of facilities at Amberley, which had to be operational by the expected delivery date of 1968. Amberley had been developed as a base during World War II and was in need of many new works for F-111 operations, including a runway extension from 8000 feet to an estimated 10 000 feet. Sutherland subsequently wrote the specifications for the No 482 (Maintenance) Squadron buildings, including the main hangar (later to be christened the 'Taj Mahal'), electronics workshop, training centre and simulator building, ground support workshop, engine field maintenance workshop, wash bay, and a specialist paint shop for the extant No 3 Aircraft Depot.<sup>25</sup> The facilities were budgeted for in 1965 at a cost of £3.9m and were ready in 1968 as similar US building plans were adopted. The Queensland Public Works



RAAF Museum

Department converted USAF designs into RAAF works requirements, and No 5 Airfield Construction Squadron built the runway extension in 1968 at a cost of a further \$2.7m. It was a team effort.<sup>26</sup>

Later, as the maintenance requirements for the F-111 began to crystallise, it was soon realised that No 3 Aircraft Depot workshops were insufficient for the expected amount and scope of depot level work. Wing Commander Bill Collins and a young aero engineer, Flying Officer Elio Grohovaz, produced a detailed technical staff works requirement in 1970 for what would soon become the new No 3 Aircraft Depot hangar and workshops. The unique design and immense size of the hangar had the workshops attached to it as they held up the massive roof.<sup>27</sup>

**The USN's F-111B Project and the Fallout for Australia**

With Congress giving General Dynamics (GD) clearance to proceed with development of both an air force and navy version of the F-111, as prime contractor, GD subcontracted to the Grumman Corporation in New York to build the USN's F-111B model. Of the projected total of 1726 F-111 aircraft to be built, 22 were intended for research and development, 1473 were for the USAF, and 231 for the USN.<sup>28</sup> The F-111B would have longer wings for extended endurance and slower landing speed, a



shorter nose to house the Navy’s air-to-air radar, and a heavier undercarriage optimised for aircraft carrier deck landings.<sup>29</sup>

The first flight of the F-111B was on 18 May 1965 out of Grumman’s Long Island plant in Calverton, New York, some six months after its USAF cousin flew. During the design phase, the USN insisted on several features which would later benefit the RAAF but, in the end, would be the naval version’s undoing. The result of the changes was a much larger and heavier aircraft that was not fighter manoeuvrable and, therefore, would not meet naval requirements for their fleet air defence aircraft. The Navy was never happy with the 80 per cent commonality compromise directed by McNamara, and by 1966, the project was in deep trouble. The last thing the Navy wanted was a 90 000 lb ‘dogfighter’ designed by the Air Force, even though they heavily influenced the final specifications. The hybrid would not be capable of the full range of navy missions and, despite a great deal of work by the contractors to lighten the aircraft, when a final study found the F-111B was still 50 per cent over weight and 44 per cent short on range, the Navy rejected it. The Navy had already begun to look at alternatives including a variable wingsweep version of the F-4 Phantom which, according to the sales pitch by manufacturer McDonnell, could be in service at the same time as the F-111B.<sup>30</sup>

When the Navy’s position became public, Senator John McClellan, who had conducted the first Congressional hearings into the TFX program in 1963, subsequently resumed the attack—this time on the F-111B.<sup>31</sup> What finally ended the F-111B project was the comment by USN Vice Admiral Tom Connolly when testifying before Congress in March 1968. Despite praising the aircraft a year earlier, Connolly commented, ‘Mr Chairman, there isn’t enough power in all Christendom to make that airplane what we want’. Congress cut the funding.<sup>32</sup> In July, the Navy formally cancelled the program with all development work wrapped up by the end of the year. By then, seven aircraft had been built after US\$378m had been spent on the program, and the

Navy turned to its own new naval design, the F-14 Tomcat.<sup>33</sup>

However, one wag at Fort Worth may have had the last laugh over the Navy’s rejection of the F-111. According to Air Vice-Marshal Dave Rogers, when the Australian crews arrived for the handover ceremony of the first aircraft in September 1968, a large sign outside the Green Oaks Motel near the General Dynamics factory, read ‘Australia: A Better Judge of Aircraft than the US Navy’. It was gone the next morning but sent the intended message!<sup>34</sup>

Despite cancellation, the F-111B left several important legacies for the RAAF. First, the longer wings were later added to the RAAF specification with a small addition to the overall cost. Second, the Navy wanted side-by-side seating which greatly improved cockpit crew coordination (now called crew resource management). Third, the Navy’s insistence on a weapons bay provided space for the later inclusion of both the reconnaissance pallet and the *Pave Tack* precision designation and targeting system in the F-111C. Fourth, a crew escape module rather than ejection seats resulted in a far higher crew survival rate after ejection. Fifth, the Navy’s later F-14 fighter’s use of the same TF30 engine and other common components meant a steady flow of spare parts continued even after the USAF F-111s had been withdrawn from service. Finally, the requirement to carry Phoenix and AIM-9 missiles meant extra wiring to the weapons stations was already incorporated into the wings, enabling the Australians to conduct a significant guided weapons clearance program without the expense and delays that a major rewiring and certification program would cause.

**A Project Management Methodology**

Given the size, cost and complexity of the F-111 project and the diversity of US agencies involved, it soon became clear that Australia’s approach to aircraft acquisition had to change. Gone were the days of a small management team in Australia set

up under the Air Member for Technical Services in Air Force Headquarters, with just an officer or two overseas attached to the embassy to monitor developments. This project would be the first of the new way of doing business and would require the RAAF to plan, cost and scope the duties of project personnel as well as carefully monitor project cost, schedule and technical matters.

The USAF’s own procurement system had gone through a major structural change since McNamara’s elevation to Secretary of Defense. Two new Commands, Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC), were formed in April 1961 out of several disparate Commands and functionalities. AFSC took over procurement and contracting functions and instituted a systems approach for acquisition. Thus were created the System Program Offices (SPOs), each dedicated to a specific weapons system, an approach the RAAF would itself adopt much later. The F-111 SPO was located at Wright-Patterson Air Force Base (AFB), Ohio and most of the acquisition management liaison was conducted there. At a mutually agreed time, AFLC accepted management responsibility of each specific aircraft type from AFSC after the last of each type had been accepted by the operating command.<sup>35</sup>

Both Commands had responsibilities to deliver air power capability, and the RAAF soon found it had to provide liaison officers in each area to represent Australia’s case and to keep the Project Manager, other liaison offices, and Air Force Headquarters (AFHQ) advised of developments. While AFSC was located at Andrews AFB, Maryland, the Command’s Contract Management Division also had offices at contractor sites where the USAF owned the main facility. Such was the case at General Dynamics Fort Worth (GD/FW) where the USAF owned Air Force Plant 4 which was used to build the F-111s. In time, RAAF resident engineers would be liaison officers to both General Dynamics and the USAF, although they mostly worked through the RAAF Project Manager at the Australian Embassy in Washington.<sup>36</sup>



RAAF Museum

**Above**  
Air Commodore Clarence ‘Spud’ Spurgeon – the first Project Manager.

Similarly, AFLC had five large logistic centres, called Air Materiel Areas, spread across the US, each responsible for specific aircraft types. For the F-111 program, the Sacramento Air Materiel Area (SMAMA) at McClellan AFB, California became a second home to many Australians posted onto the F-111C delivery, update and maintenance programs.<sup>37</sup>

The distinction of being the first Australian in the F-111 program went to Group Captain Clarence ‘Spud’ Spurgeon, who had been appointed the first RAAF F-111 Project Manager from April 1964. He would also be the first Australian to fly the aircraft when he piloted the fifth production F-111A on 8 October 1965. Spurgeon had a project engineer appointed to his staff, Wing Commander Fred



Cousins, but soon realised the project office had to expand, and very quickly. A full provisioning team was required to assess the myriad support requirements. With over 340 000 line items of support equipment and spares to be examined during the technical assessment phase, the only way to do this was to send a dedicated staff to GD/FW. In late 1965, the Air Board agreed that a team of specialists should be added to the Project Manager’s staff, so a further five officers were posted in.<sup>38</sup> As well as a presence at the USAF Program Office Headquarters in the Pentagon, additional RAAF representation would be required at the General Dynamics facility, in the USAF SPO, and at SMAMA.

The RAAF clearly had little idea at the time of what it was getting into. The project management personnel were all in the US—there was no program office in Australia, as no-one apparently deemed it necessary. Technical Services Branch fielded all the questions and reported to the Air Board who made most of the decisions. The accountants made the remainder. Soon the demand for project staff on both sides of the Pacific was realised and the idea of project management teams coalesced. Towards the end of 1964, the Air Staff apparently realised they also lacked an involvement in the project beyond the Operational Requirements – Bomber position, so a Director of Project Coordination was established under the Deputy Chief of the Air Staff. Unfortunately, this extra layer of management added very little to the process.<sup>39</sup>

In 1965, a RAAF Engineer, Squadron Leader Col Spitzkowsky, was posted from No 482 Squadron, where he had been working on Canberras, to the F-111 SPO at Wright-Patterson AFB. He was there to report on USAF developments on the F-111 program and to advise them on RAAF requirements. As the aircraft began to take shape, numerous design flaws were picked up requiring Engineering Change Proposals (ECPs) to which the RAAF had to agree. While the acquisition concept was simple—buy 24 F-111As ‘off the shelf’—it soon became clear that would not happen. Spitzkowsky became

the RAAF’s representative on the Configuration Control Board and was given a \$100 000 delegation to agree ECPs, including those for RAAF-specific requirements. The first RAAF-unique modification was the incorporation of an HF radio for long-distance communications, something for which the Americans had no need. From that point on, the RAAF F-111s were unique.<sup>40</sup> Another RAAF engineer, Squadron Leader Bill Collins, who followed Spitzkowsky into the SPO, recalled: ‘this concept of engineering change proposals and configuration management, whatever it was, was essentially new to the RAAF’.<sup>41</sup> Collins found that the majority of the change proposals were called ‘correction of deficiency’ or compatibility changes to ensure the aircraft met the specifications, and most had to be incorporated whether the RAAF liked it or not.

Soon after their arrival in country, the provisioning team of supply and technical personnel found they too had a challenge. There were approximately 70 000 line items (spare parts) that would be required by the RAAF at a cost of between US\$21m and US\$35m. The weapons system also included a simulator, 25 complex training rigs and about 1500 separate items of ground support equipment. The F-111 project would soon stretch the RAAF’s ability to cope. But cope it did, and by the late 1960s, the organisation was working well. RAAF project staff members were embedded in the appropriate US organisations and were fully engaged with their US counterparts.

The impact on the RAAF was immediate and evident. The F-111 experience of the 1960s changed the way the RAAF acquired its future capability and how it managed its current capability. Out of the F-111 project, the RAAF adopted a more rigorous evaluation process for future equipment acquisitions, instituted a project management methodology and a systems approach to managing not only the delivery of the air vehicle, but also for delivery of adequate air and ground crew training, ground support equipment, spares assessing, and production of technical manuals and instructions. Finally, the F-111 forced the RAAF to change how assets were

managed within the RAAF’s Support Command and how they were to be maintained.<sup>42</sup>

### A Step Too Far?

Although the RAAF quickly got on top of the project management aspects, had Australia taken a step too far with the F-111 capability? Indeed, was the buy a huge mistake? No other aircraft in its development or service generated so much controversy as the F-111. Continually criticised by the US Congress, the global media and in Australia by the Federal Labor Opposition in particular, the aircraft suffered ridicule and derision which was not warranted.

The acquisition of major defence projects usually hinges on three crucial customer desirables: they want it on specification, on cost, and on time; but very few if any highly technical, high-risk projects meet these ideals and the F-111 was no exception. The four controversies that plague most aircraft projects all plagued the F-111. These were arguments about its technical complexity, cost blowouts, schedule delays and, eventually, its retention in service. Roles and doctrine can be added to this list, as the main reason for which the aircraft were bought (to deter Indonesia) had dissipated well before delivery. The question about what it was for also dogged the aircraft throughout its life. Years after delivery, the F-111 strike reconnaissance force found itself struggling for a place in Australian defence and foreign policy, and thus came under regular attack.<sup>43</sup> Then there was one final controversy—the fallout from the deseal/reseal program, which left fuel tank maintenance workers with long-lasting and sometimes fatal medical conditions. That issue is covered later in Chapter 7. This chapter now examines these controversies and their impact on the RAAF, and how government policy responded to the changing circumstance.

### The First Australian F-111 Controversy – The Design

Although Menzies was triumphant with his announcement in October 1963 that Australia would get a state-of-the-art bomber which would last in service until at least the late 1970s, the press immediately began attacking the decision. *The Sydney Morning Herald* labelled it a ‘paper aeroplane’ and by all measures they were right. Full-scale development had proceeded from December 1962 and continued through the US Senate Hearings in 1963, but no aircraft had actually been built. As the TFX design evolved, it incorporated many new features, none of which had been tried before. As well as being at the leading edge of technology, the level of systems integration was much more complex than in existing combat aircraft and this meant high risk.

There were numerous technical innovations that made the F-111 unique. First was the variable wingsweep mechanism (that General Dynamics called the VASCAAR wing for variable area, sweep, camber and aspect ratio), at the time just a concept. This variable sweep allowed the aircraft to fly fast or slow depending on in-flight conditions. Variable wingsweep allowed the aircraft to fly at over twice the speed of sound in combat or down to 110 knots for landing. Second, the F-111 used a crew module that ejected the entire crew compartment in an emergency rather than use ejection seats. Third, General Dynamics chose to fit a revolutionary engine, the TF30, to power the aircraft after preliminary work on that engine for the USN’s (aborted) Missileer aircraft project had proved the engine design.<sup>44</sup> Fourth, was the fitment of a terrain following radar (TFR) that allowed the aircraft to fly very close to the ground in all weather conditions and at night. Fifth, was the incorporation of a flight control system which smoothed out pilot inputs and changes in airflow such as turbulence, thus giving the crew a comfortable ride. Finally, was an integrated navigation, targeting and attack radar system for bombing accuracy. Many industry observers felt there was too much risk in one design and that the



RAAF Museum

**Above**  
Aircraft 63-9770 was the fifth prototype and was used to test the gun.

**Above right**  
Tricks of the trade: photo-retouched for marketing purposes.

**Opposite**  
Stills from the original flight test film of the wing sweep in action. The wings could vary between 16 and 72.5 degrees in flight.

F-111 would never fly.<sup>45</sup> However, and despite these novel features, it would be commonality between the US and Australia that Menzies was really after, not technical wizardry.

After what seemed an indecent haste to sign up for the aircraft, a detailed technical agreement which ‘showed for the first time the expensive complexities of the project’ was not concluded until June 1964. Minister for Defence Shane Paltridge dispatched the Secretary of the Department of Air, A.B. McFarlane, and a Deputy Secretary from Treasury, Lennox Hewitt, to the US to ‘clean up the mess.’<sup>46</sup> On 18 June, McFarlane and USAF Lieutenant General Gerrity signed the technical agreement which prompted the commencement of work on the Australian F-111s, but as yet no formal contract to purchase had been signed.<sup>47</sup> This agreement removed all reference to the B-47s, proposed the option to take 24 F-111As

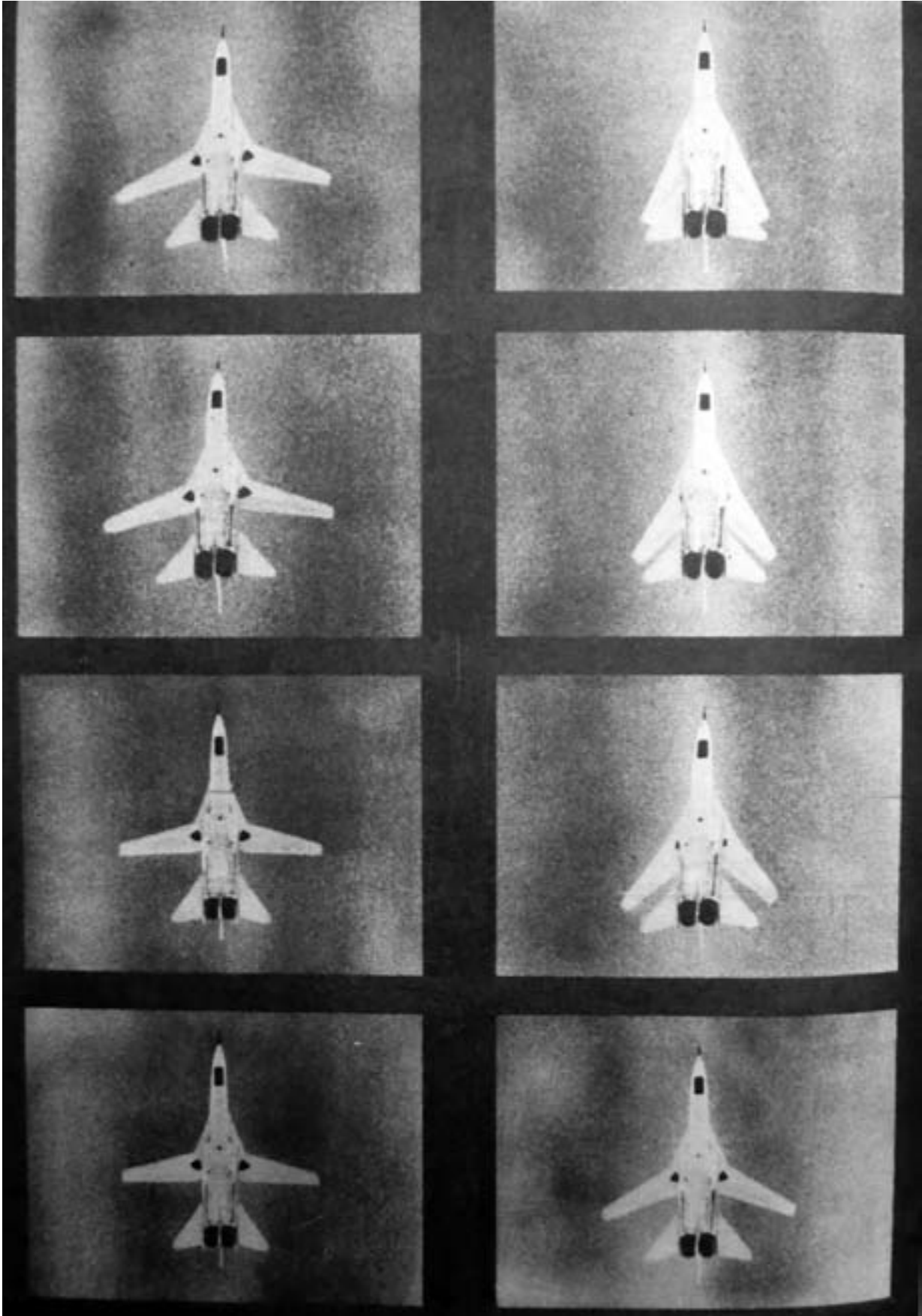


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in lieu of the agreed 18 F-111As and 6 RF-111As, and delayed delivery till 1968. To keep the Treasury happy, they also negotiated an equitable schedule of payments.<sup>48</sup>

The acquisition would be under the US Foreign Military Sales (FMS) program. Under FMS cases, the USAF was the customer, not the RAAF, so any negotiation with the manufacturer had to be approved by and conducted through the USAF Project Manager. The USAF would have the final say on modifications and changes, and this consequently led the RAAF to establish a number of other project team members spread about the country. This project would be doubly complex as, in the early days at least, the USN also had a say.

Despite the nay-sayers, the F-111 flew; and no doubt General Dynamics, the Pentagon and McNamara were all pleased when the first F-111A, Serial No. 63-9766, took off from the General Dynamics Fort Worth plant on a shakedown flight on 21 December 1964. Full wingsweep movement was proven by the second flight, and after that the aircraft aerodynamics and flight systems went into a full test program.<sup>49</sup> The demonstration prompted a letter contract signed between the USAF and General Dynamics in April 1965, agreeing the production of an initial 431 aircraft, but the company would have to wait two and a half years for a formal production contract totalling



Author



US\$1.82b, now changed to 493 aircraft, including Australia's 24 and the UK's 50.<sup>50</sup>

Unfortunately, but not surprisingly, a number of problems arose during development, not the least of which were a weight problem for the F-111B, engine compressor stalls due to the complex intake design, excessive tail drag, and the accuracy of the analogue avionics and navigation system. Later, problems emerged with the welds in the tail section actuators and fatigue cracks in the Wing Carry Through Box (WCTB) as will be discussed later. The General Dynamics program managers instituted a number of engineering fixes, but these would take time and increase costs.

The original weight of the F-111A/B design had blown out from 45 000 lb to over 70 000 lb, so a Weight Improvement Program followed by a Super Weight Improvement Program was undertaken. Although primarily intended to benefit the USN version, it was not enough to save those aircraft from cancellation, and created further problems with machining the high tensile steel components for the Air Force versions. Modifications to the intake eventually solved the engine compressor stall problem evident at higher altitudes and Mach

numbers, but a design fix to replace cowls with blow-in doors was instituted too late for the first 141 production aircraft, including the 24 F-111Cs intended for the RAAF.<sup>51</sup>

**ARL Steps In**

It was at this time that the Aeronautical Research Laboratories (ARL) in Fisherman's Bend, Melbourne, first became involved with the F-111. The ARL Supersonic Aerodynamics team designed a 1/3-scale intake model to check airflow interference effects and data was exchanged between ARL, the RAAF and General Dynamics.<sup>52</sup> General Dynamics subsequently moved the intake out from the fuselage to keep it clear of the disturbed airflow next to the aircraft skin and added 20 vortex generators (small, wing-shaped protrusions that alter the air flow) throughout the intake.<sup>53</sup> According to Air Vice-Marshal Dave Dunlop, the original design was to meet the USAF specification for radar cross-sectional area. Moving the intake out resulted in a stronger radar return, and thus a greater radar signature for enemy radars.<sup>54</sup> Finally, they retrofitted an engine upgrade from the TF30-P-1 to TF30-P-3 variant. These changes greatly reduced the problem, but some flight restrictions remained. General Dynamics engineers also reworked the splitter plate (a large protruding

plate forward of the engine intakes) which was fitted to later prototypes, on all the production F-111As and the F-111Cs. This new design was collectively called the 'Triple Plow I' inlet, as the shape of the splitter plate resembled an old style farmer's plough. The design further altered the airflow to the engine compressor face and solved the stalling problem. General Dynamics continued to work on intake design, eventually removing the splitter plate altogether to create the Triple Plow II intake. The Triple Plow II had blow-in doors as opposed to hydraulically operated cowls and this intake was fitted to the FB-111s and all F-111D/E/F variants. When Australia purchased 15 F-111Gs in the early 1990s, they arrived with the newer intakes. Figure 3-1 illustrates the differences.

New digital avionics, called Mark II, were also designed for the F-111D model. The Mk II avionics system would later create its own headaches, but fortunately the F-111C was not retrofitted. Thus the F-111C can claim to be at the peak of analogue technology, and all designs afterwards were fitted with digital avionics. In all, these cost the US taxpayer an extra \$100m, but Australia's fixed-price contract meant these costs were not passed on.<sup>55</sup>

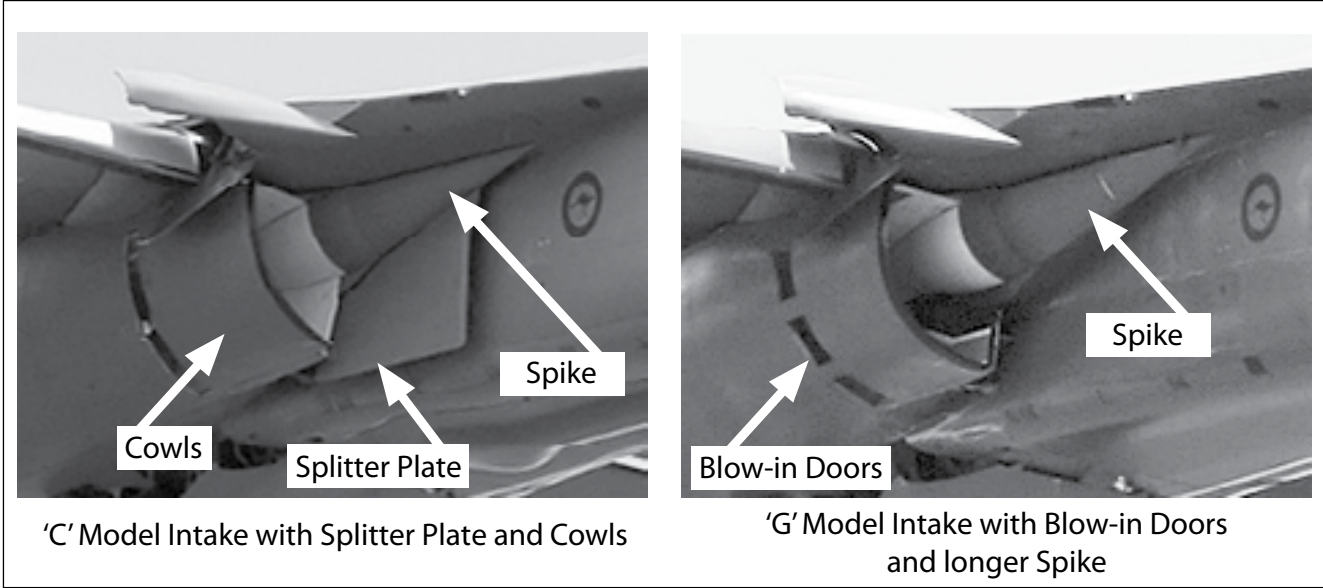
The F-111C's unique design of extended wingtips and heavier undercarriage meant it would not have the same performance spectrum as the F-111A. While, notionally, the F-111As were fighters and had a +7.33 g limit, the F-111Cs were technically bombers and had a +6.5 g limit, a subtle but significant difference due to higher design weight and the longer wings. The performance differences would later lead to the RAAF conducting its own flight trials to qualify flight manual figures and refine the mathematical models developed by the Defence Science and Technology Organisation (DSTO) that were used for weapon clearances.

With lingering doubts about the technical viability of the aircraft, on 19 September 1966, the Minister for Air announced that an Australian test pilot would be posted to Edwards AFB Flight Test Center

to fly the aircraft and to monitor and report on developments. The first F-111A to go into what the USAF called Cat II testing arrived at Edwards AFB in mid-January 1966, so trials had already begun.<sup>56</sup> It was hoped that a credible Australian presence would keep both the Government informed of F-111 test progress and silence the Opposition and media. Squadron Leader Ron Green, a senior test pilot at the Aircraft Research and Development Unit (ARDU) at Laverton was selected. After the usual settling in period, and after proving his ability to the Americans, Green was finally converted onto the F-111A on 7 February 1967, making him the first Australian to gain captaincy on type. He was attached to the F-111 Joint Test Force (JTF), together with test personnel from the contractor, General Dynamics, the USAF and the USN.

Once Green became established, he sent a copy of the F-111 Test Plan back to ARDU for consideration

**Figure 3-1: RAAF F-111 Intake Differences**



Green

**Above**  
Harry Walton (left) and Squadron Leader Ron Green in A8-126 at Edwards AFB.



and it soon became apparent that F-111C configuration differences were not being addressed. Harry Walton, a Flight Test Engineer with expertise in aircraft performance from ARL in Melbourne, was then included in the F-111 test program. Of particular concern to the RAAF was the fact that the F-111C had longer wings which gave different range performance to the American F-111A. According to Walton, their work ‘included proving the range of the aircraft for their delivery flight to Australia, thus avoiding the ignominy of delivering a “long-range” strike aircraft by ship!’ They demonstrated that the flight across the Pacific could be made unrefuelled by developing a cruise/climb technique, by loading cold, dense fuel, and by having a little extra fuel in the vent tank inside the tail fin.<sup>57</sup>

While he awaited Walton’s arrival in November 1966, Green was attached to the F-111 JTF Tropical Trials unit, which had deployed to Howard AFB, Panama. Accustomed to the RAAF emphasis on performance in the tropics, he was surprised to learn the USAF had little interest in the aircraft’s performance in hot, humid conditions. The test aircraft flew only twice during their 10-day stay. According to Green:

Emphasis was directed at the efficiency of the seals around the equipment bays, to minimise water ingress during tropical rainfall. The ‘trial’ aspect was largely restricted to morning and midday inspection of the equipment bays to assess the level of moisture ingress, and the operation of all equipments immediately after heavy rain.<sup>58</sup>

Remarkably, for an aircraft of such advanced design, the first loss of an F-111 did not occur until January 1967, over two years after the prototype’s first flight. Aircraft Serial No. 63-9774 crashed at Edwards AFB due to a combination of pilot error and poor wingsweep control handle design, and was witnessed by Green. The fatal accident caused the first of many redesigns and precipitated further delay.<sup>59</sup> Green later successfully argued to be included in all future USAF aircraft investigation boards, a major breakthrough. This allowed him to keep the Project Officer and the RAAF apprised of accident causes, subsequent modifications and changes to operating procedures, all critical for the RAAF’s build-up of expertise.<sup>60</sup>

As technical problems became known to the US and Australian media, both the USAF and RAAF went on the offensive, partly to protect their reputation and partly to prevent early cancellation. In mid-August 1966, one of the most comprehensive attacks on the F-111 program was published in *Barron’s National Business and Financial Weekly*, an economic and business review magazine, and it caused a storm of controversy after extracts were published in Australia, the UK and the US.<sup>61</sup> The misleading article suggested that the F-111 was proving to be one of the costliest failures in military aviation history and that the program had not met several key specifications. Regardless of the veracity of the argument, the article sent the RAAF and the Government into damage control. There were subsequently a number of rebuttals, including a lengthy commentary written by RAAF Wing Commander Frank Griggs who had flown the aircraft at Eglin AFB, Florida, and an offer for the Minister to go for a well-publicised flight.<sup>62</sup>

After similar criticism continued in *Time*, *Fortune*, *The Wall Street Journal*, *The Financial Weekly* and *The Spectator* over the next three years, the American magazine *Flying* eventually published a lengthy counter in a special supplement, by placing the aircraft and its codefendant, McNamara, on ‘trial’. Their article ‘The People vs. The F-111’ took a charge, evidence and verdict approach, much as in a courtroom. The editor found the aircraft not guilty

of five of the six charges and guilty with mitigating circumstances for the sixth.<sup>63</sup> But the damage had been done and the issue of it being ‘a costly failure’ continued to haunt the F-111 for years to come. Such damage control had also spread to the very top brass, with the Deputy Chief of the Air Staff, Air Vice-Marshal Bill Townsend, penning an article for *RAAF News* (which was redrafted for the *RAF Quarterly* and *Aircraft* magazines) extolling the aircraft’s virtues and assuring readers that the aircraft was perfect for the RAAF.<sup>64</sup>

The Australian media naturally were keen to take up the case against the aircraft as bad news sold newspapers, and a string of sensational, if inaccurate, reporting in mid-1969 caught the Gorton Government by surprise. The Prime Minister called a Cabinet meeting after which he reiterated that Australia would continue with the F-111 program, although the message barely got through.<sup>65</sup>

**The Second Australian F-111 Controversy – The Cost**

Once problems with the design had been solved and the aircraft flew successfully, the next issue to hit the media was escalating costs. From a commercial perspective, cost is calculated from a combination of project cost, including a risk factor, company overheads, and profit. The rather open-ended negotiation that Townley and McNamara had agreed to of US\$125m was never going to be sufficient for 24 high-performance aircraft that were still on the drawing board, let alone their support equipment, simulator, spares and training. While the US\$5.21m per aircraft was soon to be capped at US\$5.95m, that did not include research and development expenses, the ‘on-costs’ such as materials and labour, and did not factor in some costly but essential engineering change proposals agreed by the RAAF.<sup>66</sup> Neither were the six RF-111 pallets included or any weapons, specialist test equipment or the facilities works required at RAAF Base Amberley. Consequently, it is hardly surprising that the program trebled in cost between order and delivery.



RAAF Museum

**Above**  
The prototype F-111A lines up for its first flight – 21 December 1964.

**The Final Technical Issue – The Gun**

The final technical issue that had to be resolved was the gun. Given the F-111 design was for the USAF's Tactical Air Command commanded by fighter pilots, the aircraft was designed with a gun at their insistence, ostensibly for air-to-air combat.<sup>67</sup> The gun chosen was the already proven M61A1 20 mm Vulcan cannon that could fire up to 6000 rounds per minute. Realistically, the aircraft was a bomber and the days of dogfighting or strafing runs over enemy airfields with such a large aircraft had ended, particularly as the F-111 was designed to operate unsupported and be flown mainly at night. Consequently, and given the RAAF specification had no requirement for a gun, in 1967 the Air Staff sought to have the gun removed by incorporation of an Engineering Change Proposal or ECP. The intention was to create more internal weapons bay space—either for additional weapons or fuel. However, the high cost quoted by General Dynamics for incorporation of the ECP, of US\$470 000, made removal too expensive, so the gun was retained. Although remaining a TAC requirement, the clearance and certification of the gun became a nightmare requiring further modifications to make it work. On 2 January 1968, F-111A (Serial No. 65-5701), was lost due to a fire in the gun bay after ammunition 'cooked off', and the crew ejected. These modifications amounted to \$290 000 per aircraft; so again, the RAAF let the gun clearance lapse.<sup>68</sup>

Trials on the gun had been conducted as part of the acceptance testing for the aircraft, but in the early 1980s, Wing Commander Dave Rogers at Headquarters Operational Command (now Air Command) argued that gun firing should recommence. Rogers felt that as the aircraft were being used in the maritime strike role, and as the RAAF had been advertising it could use the gun for strafing small boats and riverine craft, it should be demonstrated from time to time. He won the support of the Chief of Staff, Air Commodore Ray Funnell, who agreed that trials should resume. According to Rogers, 'we never used it [the gun] ... I

proposed we do a short "trial" program but advertise it widely as a gunnery program to create the impression that the RAAF does use the gun in the F-111'.<sup>69</sup>

While the gun had some utility, it was only fired on a few occasions, including a ground firing at Amberley that resulted in damage to the strike camera cover—poor harmonisation resulted in rounds shattering the glass. Other problems included excessive vibration, cartridge jams and overheating. Consequently, the gun was not used on a regular basis and, with the introduction of both the reconnaissance pallet and *Pave Tack*, the gun was finally removed.



**Above**  
Armament fitters learning to service the F-111's Vulcan cannon. L-R: Technical Sergeant Ken Potts (USAF), Aircraftman Greg Toovey, Leading Aircraftman Kev Brown and Leading Aircraftman Danny O'Heir

After the technical agreement had been concluded in June 1964, the loose arrangement with pricing also was in need of tightening. In April 1966, Secretary of the Department of Defence, Sir Edwin Hicks, met with US Deputy Secretary Cyrus Vance to negotiate the pricing, configuration and implementation agreements, including the acceptance of what now had become a US\$205m bill. However, the debate about the accuracy of these costs flared again when Britain unexpectedly announced an order for 50 F-111s that would have the designation F-111K.



Defence PR

**Above**  
Sir Edwin Hicks, Secretary of Defence. Hicks negotiated the price of the F-111 deal in April 1966.

**The British F-111K and its Price**

Given the trauma created by the Wilson Government's cancellation of TSR2 in April 1965, and the RAF's pressing need for a nuclear and conventional low-level strike aircraft to replace their Canberras, it was perhaps not surprising the British quickly turned to the F-111 option as there were no other suitable candidates available. Although opprobrium was heaped on the Wilson Government over cancellation of the TSR2 on what were seen as dogmatic Labour Party policy grounds, the decision was not that simple. Between January and late March 1965, considerable cross-Ministry staff work went into a full cost-benefit analysis of TSR2 versus F-111A. The Government was losing £1m Sterling a week on TSR2 and were keen to cut expenditure.<sup>70</sup> On 26 March 1965, the UK Defence and Overseas Policy Committee submitted its findings to Cabinet that 'The TSR2, is thus, based on these highly tentative estimates, between 23% and 34% dearer than TFX'.<sup>71</sup> With that the axe fell on the TSR2 and negotiation began between the Ministry of Defence (MOD) and the Pentagon on acquiring the F-111.

The RAF wanted 100 aircraft, enough for seven operational squadrons, a training and conversion unit, and attrition spares. But again, full funding was not available, so the number was halved. On 22 February 1966, the UK Government pre-empted any final Ministry of Defence review, by announcing the order of the F-111K and, in May, a production order was signed for an initial 10 aircraft. On 31 March 1967, the UK Government took up the option for the additional 40 F-111Ks to complete the order at a total cost of £280m.<sup>72</sup>

The British order was based on the FB-111A configuration, with heavier undercarriage and shorter wings, but the specification was later changed to be more like the F-111C with longer wings. However, in the following months, there was much media discontent about a non-British aircraft being selected, despite the fact that the British F-111s were to be fitted with Rolls-Royce Spey engines and



British avionic components, and the Government got cold feet.<sup>73</sup> Within eight months the decision to buy the F-111K was reversed and this order too was cancelled.<sup>74</sup> Only two F-111Ks were ever completed and, after reconfiguration, were added to the USAF FB-111A fleet. Cancellation was costly for the British with US\$150m in fees and a further US\$129m in lost contract costs awarded against them.<sup>75</sup> Afterwards, British industry struggled to collaborate with the French on a proposed Anglo-French variable geometry aircraft until the French withdrew to concentrate on developing their Mirage G variable wingsweep fighter, and the British eventually went on to the more successful collaborative Tornado program some 10 years later.<sup>76</sup> The fallout of the UK Labour policy on defence and the cancellation of both TSR2 and the F-111K also sealed the fate of RAF Bomber Command which, between 1965 and 1968, handed over the nuclear deterrent role to the Royal Navy. Deprived of its strategic strike role, Bomber Command merged with RAF Fighter Command in 1968 to form RAF Strike Command with just a conventional bombing role.<sup>77</sup>

While a second overseas customer may have provided more bargaining power for the RAAF, the pricing of the UK option was to cause some discontent in Australia. This was especially so given that the original quoted price for the Australian deal of US\$125m was an estimate only and there were clear indications that this would rise. It was the release of the 1965 British Defence White Paper and several news articles which quoted the expected F-111K unit price of £2.5m Sterling (including £400k for design changes) vis-à-vis about £2.975m for the F-111C that got the Australian Government's attention, especially inside Treasury. It looked like the RAF was getting a much better deal.<sup>78</sup>

The Australian Minister for Defence, Senator Shane Paltridge, corresponded with McNamara regarding the British price. McNamara replied that a firm British order of 10 aircraft would be price capped, but he gave no promise of price should the British order extend to the 100 initially expected. He went

on to explain that the pricing for Australia would 'not exceed the cost as calculated under our formula with the United Kingdom' but with the proviso that it was subject to 'such adjustments as are necessary to achieve comparability between United Kingdom and Australian procurements' and any legal constraints upon him at the time.<sup>79</sup>

Cabinet reviewed the cost arrangements including firm data from the USAF Program Office of US\$205.3m (A£92m) and, despite an almost doubling of the 1963 cost estimate, agreed not to push the point as 'any attempts to pursue the matter could damage our position in regard to future procurement of defence equipment'. McNamara was advised that Australia was happy with the cost arrangement but while the RAAF may have been, the Prime Minister's Department was not.<sup>80</sup> The increase in cost from A£56m (October 1963) to A£110m (February 1966) was 'deeply disturbing' and 'this problem has become so large – it extends effectively to the balance and financing of the whole Three-Year Defence programme, and the Government's public position on defence'. The Secretary of the Prime Minister's Department acknowledged that while it was too late to review the decision to purchase the aircraft, he called for 'a secret but high level departmental committee to examine the problem'.<sup>81</sup>

The Treasury was right to question the price. In its F-111 program cost estimate of mid-1966, the USAF program costs were US\$3.725m per F-111A, US\$3.997m per F-111K and US\$4.434m per F-111C, the result of unit cost by number of aircraft plus a proportion of research and development expenses. While it was to be expected that with an order of 697 the USAF's F-111As would be cheaper, the UK's 50 and the RAAF's 24 should not have been out by over 10 per cent.<sup>82</sup> It was also to be expected that, as the UK version was to have considerable changes made to its configuration, including British engines and avionics, any additional research and development costs would have been passed on only to them.<sup>83</sup>



Defence PR

**Above**

Allen Fairhall, as Minister for Defence, dispatched Hicks to examine the F-111 deal.

Rather than settle for yet another committee consideration, new Minister for Defence, Allen Fairhall, dispatched the Defence Secretary, Sir Edwin Hicks, and a small team to the US to review this and other matters. Sir Edwin tabled his report to Cabinet at the end of May 1966. His report was up-beat and, after being placated on unit pricing, contained a number of additional recommendations beyond the matter of cost. However, during their discussions, it came as a shock to Hicks, and to Murdoch in particular, that after prototype flight testing, the range of the aircraft was actually 23 per cent less than predicted. This would not meet the ASR specification, so the Australians were given three options: accept the F-111A design as

is; swap to the FB-111A design (and accept a delay and a higher cost) or modify the F-111As on order to include the FB-111 wings and landing gear.<sup>84</sup> Given that Australia's operating airfields were not likely to be as well prepared as those in the US, the heavier (and thus stronger) landing gear seemed logical and Australia needed an improvement in range. More importantly for Hicks, Australia would get the aircraft for a capped price of US\$5.95m, the same as eventually struck for the UK. Hicks' recommendations were accepted and included the extended wingtips and a strengthened undercarriage (a total cost US\$2.7m), a retrofit of six aircraft as reconnaissance versions, and the commissioning of a joint USAF-RAAF examination of support facilities intended to benefit both parties.<sup>85</sup>

The endorsement would set a new path for Australia's F-111A fleet. The modifications were to be relatively cheap since the extended wings (by about one metre each wing) and the heavier undercarriage had already been designed, tested and flown. The engineers had calculated that extending the wings would give another five per cent in range (about 55 nm) and cost \$33 000 per aircraft, while the heavier undercarriage would allow increased bombloads to be carried to a radius of 1100 nm.<sup>86</sup> Because the configuration changes made the Australian F-111As unique, the designation was changed by the SPO and General Dynamics to the F-111C.<sup>87</sup> Although the Minister's announcement to the Australian media on 1 June 1966 of the adoption of the longer wings and heavier undercarriage had effectively created the F-111C, the designation was not officially applied until December that year.<sup>88</sup> The redesignation had another unintended consequence. Now, as a non-USAF common aircraft, the cost of changes and Australian-unique items immediately went up. According to Spitzkowsky: 'For instance, the price of technical manuals went up by something like \$2.5m because we could no longer just use the ones produced by the USAF. Ours had to have F-111C at the top of every page and in many cases that was the only change.'<sup>89</sup> Moreover, the retrofit of six (later downsized to four)



aircraft to RF-111C status would take a further 12 years because it was not seen as a part of any USAF modification program.

**The Australian F-111 Cost Blow-out**

The questions of cost and schedule would not go away and the Government was faced with a two-pronged attack by the Opposition and the press. Central to their criticisms were the extraordinary cost escalation and unending delays to delivery. Cost, however, was paramount. It was already apparent that the US\$125m was more of a guess than based on fact and the cost of the project would almost treble before delivery in 1973. After a formal internal costing review in June 1966, the USAF predicted a total payout of US\$177.4m for Australia's 24 production aircraft, but this figure did not include flight testing or other costs, such as simulator, test equipment or training.<sup>90</sup>

Although continually trumpeted by *RAAF News* that the 'F-111 Bomber [was] on Schedule', cost was the problem. By late 1965, the cost of the F-111 project had risen to US\$205m (A\$184m), an increase of around 60 per cent on the initial guess. While the media had a hint of this for some time, Minister for Air Peter Howson was forced to publicly admit the increase in Parliament with his statement being widely reported.<sup>91</sup> Eighteen months later, in April 1967, the official USAF estimate of US\$238m for the project was put forward, but the RAAF estimate at the same time of US\$294.6m was almost spot on as the later Cabinet Submission for April 1968 would indicate.<sup>92</sup> For the first time the Government seriously considered cancellation and replacement with F-4 Phantoms.<sup>93</sup> By late 1967, the media were already speculating that including other elements of the F-111 weapons system would raise the cost considerably, 'possibly to \$300m'.<sup>94</sup> Compounding the Government's woes over the matter was a statement by Henry Kuss, US Assistant Secretary for Defense – International Logistics, implying the aircraft's maintenance would cost one half of its original cost

every five years, a comment that also generated a barrage of Opposition questions.<sup>95</sup>

The Australian F-111 project had been capped at US\$5.95m per aircraft, but this did not include escalation for labour costs, modifications (such as longer wings and heavier landing gear), or other improvements agreed by Australia. Consequently, another review in August 1969 calculated the per-unit cost as US\$7.48m, an increase of over 25 per cent. Cost was also raised by the US Senate Committee on Government Operations during their second (1970) round of TFX investigations. The Chair, Senator McClellan, was concerned that Australia was being subsidised by the US taxpayer, but it transpired that the flyaway price for Australia would be US\$7.48m against US\$6.96m for the American version. When spares, ground support equipment, trainers, data and training were included, the unit cost for the Australian aircraft rose to 'about US\$12m'.<sup>96</sup> The RAAF's F-111 acquisition was finally listed as US\$324.5m or \$13.52m each.<sup>97</sup>

So what was the actual cost in Australian dollar terms of Australia's F-111C purchase? When asked this question in Parliament in April 1980, then Minister for Defence, Jim Killen, stated the final cost was 'A\$260.963m, with modifications totalling A\$16.35m or A\$10.8m per aircraft'.<sup>98</sup> Killen's answer was not qualified, but the low figure probably does not include all the add-on costs previously mentioned.

**The Third Australian F-111 Controversy – The Delivery Schedule**

From almost the day the F-111 was ordered, there were questions raised about development time and delivery. The major newspapers carried the purchase announcement as headlines for three days and as the details emerged, *The Sydney Morning Herald* astutely pointed out in its page one headline: 'Aircraft deal "binding" Australia to American strategy', and raised early doubts about the 1967 delivery date.<sup>99</sup> The commentary would be proven correct. A year later, *Aircraft* magazine ran the comment: 'In Australia,

the political sniping directed at the F-111A and the order for 24 of them placed by the RAAF has been largely directed at the question of schedules', a point made after announcement of a deliberate slippage for delivery to late 1968.<sup>100</sup>

As well as facing rapidly increasing costs, the F-111 project was suffering a number of development delays, not the least brought on by solving the USAF-USN commonality issue and several technical problems. Once the USN had pulled out of the deal, the USAF and General Dynamics could concentrate on a number of fixes, including the intakes, avionics and several emerging material problems that became apparent during manufacture. The RAAF was also assured that the USAF could not afford to let the aircraft fail.

The first issue raised was development time. While Australia waited, and despite the urgency placed on the delivery by those ignorant of technical complexity and system integration, the F-111 program performed better than all the Century Series fighters and later bomber developments. The first flight was just over two years from contract acceptance, and the aircraft was operating in USAF squadrons three years later.

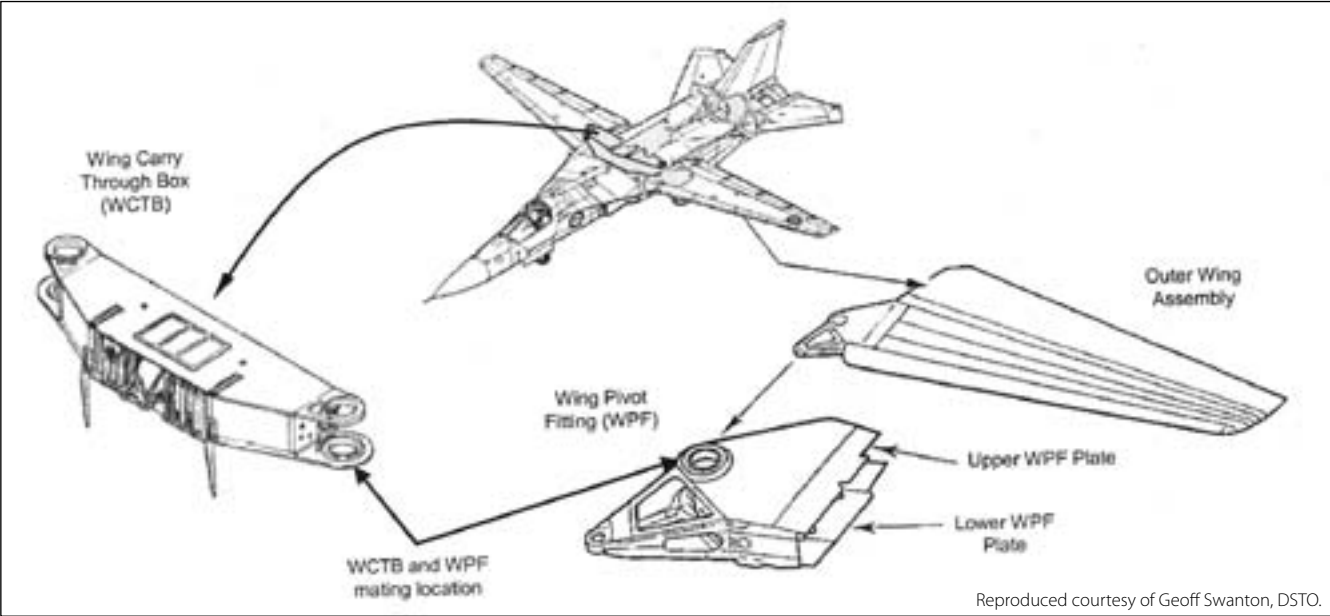
Until the 1960s, American aircraft designers did not have to worry too much about metal fatigue because aircraft were not kept long in inventory and inspections normally located problem areas well before failure. Increasing costs and complexity meant this would have to change and methodical fatigue testing on critical components was begun. To help predict aircraft life, engineers use a number of fatigue tests on these critical structures. They use 'safe life' methodology, in which a structure is replaced before it is time expired, well before cracks appear; and 'fail safe' methodology, in which the structure is designed with a number of sections all sharing the load. In the latter, the structure can be safely used until cracks appear, as other components can take up the load bearing—hence it is 'fail safe'. This is the design philosophy used in the US, and by running tests

to see when cracks appear, engineers can calculate the number of flying hours likely before component failure. While all aircraft are regularly inspected for both fatigue (cracks) and corrosion (metal deterioration) and repairs made when necessary, for larger components such as wing spars, tailplanes and fuselages, it may not be possible to predict when the aircraft should be retired.<sup>101</sup>

Such was the case with the F-111, but only after a number of crashes led investigators to suspect problems with both the horizontal stabilisers (the horizontal tail section) and the swing-wing mechanism, and for the latter, with the special type of steel (called D6ac) and the way it was manufactured. Three critical areas would cause fatigue problems and each would take time, money and considerable engineering effort to fix. These were the Horizontal Tail Servo Actuator (HTSA), the Wing Carry Through Box (WCTB) and the Wing Pivot Fitting (WPF).

The first problem was a failure in the HTSA. After two similar unexplained losses in 1968 due to tail problems, the USAF undertook a full investigation. While the March 1968 loss of an aircraft in Thailand (a USAF F-111 deployed for operation over North Vietnam) was initially thought to be due to a tube of solidified sealant jamming the horizontal tail control system, upon further investigation it was found to be caused by a weld failure inside the horizontal tail servo actuator mechanism itself. This had caused the actuator to 'hunt' and the aircraft to pitch up and down uncontrollably. The HTSA drives the horizontal tailplane stabilisers and without normal operation, the flight controls are ineffective and the aircraft cannot be controlled. HTSA failure was the cause of a further accident near Nellis AFB in May 1968, the eighth loss overall and this resulted in an immediate grounding of the entire fleet while a fix was found.<sup>102</sup> In this case, the crew ejected and reported that the controls had malfunctioned and, again, the loss was found to be a weld failure in the HTSA. This put back delivery from July to September. With the pending handover of the first

Figure 3–2: Location of the critical wing sections.



Cottee

**Above**

The cause of all the trouble – F-111 Wing Carry Through Boxes awaiting inspection at the General Dynamics plant.

Australian F-111C, this was seen as yet another problem with the ‘jinxed’ aircraft and, again, there were further calls for project cancellation.

The next problem that arose was not such a quick fix, and took several years to resolve. Several major components of the F-111 wings and fuselage were made out of an extremely strong, high tensile and lightweight but brittle metal called D6ac steel. The material was extremely strong and its load bearing capacity made it ideal for the unique Wing Carry Through Box structure. The WCTB, as it became known, was the centre section of the aircraft where the wing pivot fittings were located and where the entire structure was attached to the fuselage. The WCTB and its D6ac steel was an integral and critical component of the entire aircraft manufacturing process and its failure during fatigue testing almost led to the cancellation of the entire program. The way this was remedied is covered in the next chapter. The third critical component to fail was the Wing Pivot Fitting or WPF. A small flaw, undetected during manufacturing inspection, led to four catastrophic fatigue test failures and one fatal crash, and again, delayed the delivery of the RAAF F-111 fleet.



RAAF Museum

**Above**

The first Australians to train on the F-111 in October 1967. In their distinctive peaked caps standing L-R: Flight Lieutenants Ivan Skipworth, Neil Pollock and Bob Bruce. Crouching L-R: Flight Lieutenants Ian Westmore and Bernie Johnson (simulator instructor).

**Training Commences**

With aircraft delivery expected between July and December 1968, the RAAF made plans well in advance to send air and ground crews over to the US for training on the F-111 and its systems. On 21 September 1967, Minister for Air, Peter Howson, announced in Parliament that 24 crews would go to the US for four months training partly at Cannon AFB, New Mexico, and partly at Nellis AFB, Nevada.<sup>103</sup> Meanwhile, four RAAF instructors were already in the US and would soon return to train further personnel at Amberley in preparation for the aircraft’s arrival.<sup>104</sup>

Four aircrew courses were established, each with six crews of both pilot and navigator.<sup>105</sup> The intention was to stagger the training throughout 1968 and then to ferry the aircraft back to Amberley in batches of

six. The problem for the RAAF’s bomber force back home was that these courses stripped all available aircrew, and squadron operations virtually ceased. Nos 1 and 6 Squadrons went onto a cadre basis, No 2 Squadron was in Vietnam, and No 1 (B) Operational Conversion Unit (OCU) was fully occupied converting and training crews for the next Vietnam aircrew rotation. Had any other regional threats emerged, Australia would have had to rely on the fighter force to conduct any bombing operations.

The Australian F-111 aircrew course members would first attend a three-week radar scope interpretation course at Mather AFB, near Sacramento, California. Here at the USAF’s navigator training school they were taught radar techniques using B-52 radar simulators by experienced navigation instructors, whom the USAF called Weapon Systems Operators or WSOs. Few Australians had seen a ground mapping radar scope, let alone interpreted one. None had seen a terrain following radar (TFR). Following the radar courses, the first two batches of crews went to Cannon AFB, New Mexico where they undertook four months of F-111 training in the right-hand (navigator’s) seat. One of the pilots on the second course, Air Vice-Marshal Dave Rogers, later recalled:





Rogers

**Top**

Australia's F-111Cs under construction in 1968.

**Above**

Major Jim Sharpe, USAF instructor pilot, and Flight Lieutenant Dave Rogers – original conversion in 1968.

**Opposite**

No 2 course at Cannon AFB, May 1968.

There were no pilots there, only navigators to teach us, so we had to learn how to fly the simulator ourselves. None of these navigators had flown the F-111, but they knew their subject very well, they were good in terms of radar scope interpretation ... in that time, we had to do 16 rides in the simulator, 32 hours. The simulator was the only one in the Air Force at that stage. It worked 22 hours a day, the other two hours in maintenance ... I guess we came out of Cannon full bottle on the aeroplane on the right-hand side, but not much on the systems.<sup>107</sup>

After Cannon, they travelled to Nellis AFB for another two weeks of ground school, including more simulator work, and commenced flying. Rogers continued: 'We did about 33 hours each. You had to do five rides ... then you went solo.' Once pilots had gone solo, they went on to weapons training, terrain following radar flying and air-to-air refuelling, something none had done before. Missing from the US training package was any training in operational employment techniques, electronic warfare or weapons, and any understanding of just how the aircraft were to be used. However, it was a conversion course only, with the missing elements supposed to be conducted at Amberley.<sup>107</sup>

As well as crews sent over to train on the aircraft, a small team went to the simulator manufacturer, Singer-Link in Binghamton, New York. Their task was to set up the simulator training package for technicians and work on the syllabus for aircrew. The simulator had been bought as part of the F-111 deal and was essentially an F-111A simulator with F-111C painted on the side. Squadron Leaders Ian Andrew and Bernie Johnson were intended to become simulator instructors back at Amberley, but in the end only Johnson was posted there. Their first challenge was to determine whether or not to buy a visual system, which they wisely discounted as the graphics and quality were not good at that stage in simulator development. However, the main issue was getting performance data for the Australian simulator model which differed from the American version due to the F-111C's longer wings. This ended up being extrapolated from General Dynamics data and some

flight test data done at Edwards.<sup>108</sup> They returned to Australia at the end of 1968, but although the aircraft was delayed, at least the simulator was available. Likewise, engineering officers and technical airmen completed courses on the simulator, engines, electronics, armaments, airframe, radar and automatic test equipment. Most training was completed at Nellis. By November 1968, a total of 526 personnel had been trained in the US and Australia, but by then the aircraft was grounded awaiting structural repairs.<sup>109</sup> Then Squadron Leader Greg Grantham recalled of the airmen that 'we soon had massive morale problems as the aircraft didn't arrive. I found myself looking after over 400 people with nothing to do. So we organised extra training courses for them.'<sup>110</sup> There was little else to be done. All now awaited the arrival of the aircraft and so began a massive training effort back in Australia.



82 Wing



Building on training experience from the Mirage introduction and knowledge gleaned from the USAF, maintenance courses were established for all technical trades in the facilities at Amberley using an extensive series of system training aids bought as part of the project. According to Wing Commander Ian Sutherland, the second Commanding Officer of No 482 Squadron, ‘the professionalism built into RAAF tradesmen by this process stood units in good stead in producing high quality maintenance work and ensured subsequent personnel turnover did not affect this vital quality standard.’<sup>111</sup>

### 1968 – A Year of Frustration

By the end of 1968, it appeared that there would be no F-111 for Australia. Problems with the aircraft structure were compounded by unexplained losses of USAF F-111s in Vietnam. It meant further investigations and more delays. The Gorton Government came under intense political and public pressure to cancel the program and retreat to a safer option. It was during this waiting period that the RAAF and the scientists at DSTO applied their knowledge to help remedy the structural problems and the aircraft was finally accepted.

1968 was the F-111’s *annus horribilis*. The F-111B and F-111K were cancelled, the Mark II avionics which went into the F-111D (a derivative of the F-111A) were not working, and a major part of the wing structure had cracked during fatigue testing, well before design limit predictions. To compound matters for the Australian Government and the RAAF, the deployment of six USAF F-111As to Vietnam that year had resulted in the unexplained loss of three aircraft within the first month, a human and public relations disaster. Questions about combat losses and fatigue problems were to delay the delivery and consume the Air Board’s time. The entire program was now at risk.

In 1967, after stinging criticism in the United States media and Congress, the USAF staff in the Pentagon thought a demonstration of the F-111 under combat

conditions was warranted to prove the viability of the aircraft. There was also some rivalry as the USN had already deployed their A-6 Intruders in the night precision bombing role, the same role intended for the F-111. The USAF’s decision also coincided with the announcement of President Johnson’s sequential bombing campaign called *Rolling Thunder*, which restricted heavy, area-bombing from B-52s and instead concentrated on ‘tactical targets’ such as bridges, rail junctions and the like. Such pinpoint targets would be perfect for the F-111 to demonstrate its capability and silence the critics.<sup>112</sup>

The first production F-111As were delivered to the USAF on 18 July 1967 to the 428th, 429th and 430th Tactical Fighter Squadrons of the 474th Tactical Fighter Wing at Cannon AFB, New Mexico. The Wing relocated to Nellis AFB, Nevada, in 1968 and began operational conversion onto their new aircraft. By then, the USAF generals had already decided to try the aircraft in Vietnam. To better prepare TAC’s fighter-bombers for Vietnamese ‘tactical targets’ under *Rolling Thunder*, new US Pacific Air Forces Commander, General John Ryan, commissioned operational testing at Eglin AFB, Florida, under a program called *Combat Bullseye*. This involved trials of various fighter-bomber aircraft conducting blind radar bombing in preparation for night attacks against Hanoi and other targets in North Vietnam. *Combat Bullseye* was a test of accuracy and was used to shake down problems with aircraft radar, navigation, sensors and targeting systems. These tests involved F-105s, F-4s, B-58s and the F-111A. After considerable analysis of results, the Combat Task Force Report of October 1967 found that a Circular Error Probable (CEP) of 200 ft or less would be required.<sup>113</sup> Although none of the aircraft could produce that accuracy, the F-111 came out well on top, so amongst other recommendations to come from the *Combat Bullseye* exercise was a deployment of up to six F-111A aircraft for evaluation in actual combat. The aircraft would be based out of the Royal Thai Air Force Base at Takhli and would operate into North Vietnam as part of the *Rolling*

*Thunder – Program 54*.<sup>114</sup> The deployment was no secret and was reported in the US and Australia, mainly because the USAF was seeking good publicity and the RAAF wanted to show off its new bomber aircraft’s capability—conveniently in Australia’s area of interest.<sup>115</sup>

Preceding the deployment were two other development programs: *Harvest Reaper* and *Combat Trident*, both conducted at Nellis AFB, Nevada. *Harvest Reaper* was an evaluation program intended to fix several of the known F-111 shortcomings to better prepare the aircraft for combat, especially night and bad weather strike operations. Begun in June 1967 with aircraft numbers 37 to 42 (with three others for backup), the intense program ran for several months and concentrated on fixing problems in the avionics and electronic countermeasures systems, and was to greatly benefit the RAAF as the F-111Cs were all fitted with the improvements. Conducted in parallel with *Harvest Reaper* was *Combat Trident*, a program begun in July 1967 to retrain F-105 combat veterans on the F-111 and thus increase the chances of success.<sup>116</sup>

The *Combat Lancer* program (the actual deployment to South-East Asia) was essentially an extension of *Harvest Reaper*, with operational lessons being seen as extremely valuable to the whole F-111 weapons system development program. Not only would any ‘lessons learned’ be incorporated into the F-111A models, but also into the FB-111A nuclear bombers for SAC and planned new variants such as the F-111D, E and F models. Immediately, there were two problems. First, the whole deployment had a strong political imperative and was rushed, probably six months before the aircraft and crews were fully ready. Second, TAC chose to use two-pilot crews: the idea of a Weapons System Officer (WSO) or Navigator sharing the cockpit of a ‘fighter’ aircraft was anathema the majority of fighter pilots in the Command. This led to disgruntled fighter pilots doing the WSO job for which they were neither trained nor interested. Their primary aim was to get into the left (pilot’s) seat as soon as they could



USAF

#### Above

Classic USAF shot of an F-111A from the 474th Tactical Fighter Wing flying over the Laotian hills in 1972. The F-111s returned to Vietnam to prove a point.

to log first pilot flying hours. The fact that the F-111 was designed as a two-crew operation and that the WSO was a highly skilled job seemed irrelevant. It was not until the F-111 Wing at Nellis failed an Operational Readiness Inspection shortly after the end of the Vietnam War, that the crew composition was changed, and ex-B-52 and B-58 WSOs or tactical navigators were posted in.

Nevertheless, on 17 March 1968, six F-111As arrived in Thailand to be met with much fanfare and a row of USAF generals.<sup>117</sup> Despite the rush to get over there, the USAF had given careful thought to the Vietnam program. The plan was to use the F-111 as it was designed: in bad weather and at night and at a utility rate of 0.66 sorties per day. A typical mission profile was High-Low-High, carrying electronic countermeasure pods, AIM-9B air-to-

air missiles, a gun in the weapons bay, and up to 14 x M117 (750 lb) bombs on the wing racks. In this configuration, a mission radius of around 680 nm was predicted.<sup>118</sup> Eight days after their arrival, the F-111s flew their first (uneventful) mission against the Vung Chau truck park on a standard bombing route called Route Pack 1. It was the start of a short and unhappy deployment and it was not long before problems became apparent. Two aircraft crashed in quick succession in the first month and while two replacement aircraft were sent from Nellis, one of these was also lost a few weeks later, cause unknown.<sup>119</sup>

Australia had been benefiting from the *Harvest Reaper* program with engineering change proposals (ECPs) mostly accepted by the project office and Air Force Headquarters. It was during this work up that Spitzkowsky, working in the F-111 System Program Office at Wright-Patterson AFB, heard about the plan to deploy to Thailand and advised Air Force Headquarters that it was an opportunity too good to miss. As well as taking the opportunity to examine aircraft performance under combat conditions, the RAAF could monitor how the aircraft performed in the tropics and confirm the veracity of the design—the main problem worrying many back in Australia. Spitzkowsky ‘contacted Washington and got clearance for two RAAF personnel to go to Takhli as observers’. As he later stated, he felt it was critical, mainly because he was ‘well aware of the difficulties the RAAF had in operating previous aircraft including Sabres in the tropical conditions at Darwin’ and that ‘the USAF was not planning much in the way of tropical conditions evaluation.’<sup>120</sup>

The USAF agreed and Wing Commander Roy Frost<sup>121</sup> and Spitzkowsky were sent to Takhli as the first RAAF observers. They went with instructions to observe the operations, ask questions and report findings back to Australia. Frost reported on operations and Spitzkowsky on engineering aspects. As well as this pair, the RAAF established a two-month rotation with several officers following in quick succession.<sup>122</sup>

Initially, *Combat Lancer* missions were flown by single aircraft at night into South Vietnam, but soon turned against targets in the northern regions around Hanoi—the so-called Route Packs 5 and 6. In all, only 55 combat sorties were flown under *Combat Lancer* as the three losses created great uncertainty about the aircraft and particularly its TFR system, and the aircraft spent a lot of the time grounded.<sup>123</sup> At midnight on 1 November 1968, President Johnson ended the *Rolling Thunder* bombing campaign, and on 22 November the detachment returned rather dejectedly to Nellis, aircraft performance restrictions making it apparently unviable in the South-East Asian theatre.

As far as feedback to Australia was concerned, Wing Commander Lyall Klaffer later commented that he was given unfettered access, attended all briefings and debriefings, and soon became familiar with operations. The engineers spent their time on the flight line and the maintenance hangers doing likewise. After their attachment, the Australians returned home to await the F-111s’ arrival, then due at the end of the year.<sup>124</sup>

After the first two USAF combat losses, back in Canberra the F-111 became ‘open season’. On 2 April 1968, a member of the Federal Opposition, Frank Stewart, rose during Question Time and asked a loaded, if humorous question of Allen Fairhall:

My question is addressed to the Minister for Defence. Does he still believe that the F111 aircraft is a super battle bird and the greatest thing with wings since angels? Does he still believe that it is the Cadillac of the air, that it flies high and low, fast and slow, throws a power punch tougher than five World War II heavy bombers and sniffs out targets like a thirsty vampire? Does he still believe regardless of cost we will be getting our money’s worth with this aircraft or have two things happened in the last 7 days which have caused him to make a reassessment of the situation?<sup>125</sup>

The two things that happened was a reference to the loss of the first two *Combat Lancer* aircraft. Minister

Fairhall deferred his answer to a later time, but the worry was that the aircraft was accident prone and incapable of combat operations. Stewart’s quote was attributed to the US media and had been used in Parliament before. In this case Stewart conveniently failed to complete the original wording which continued: ‘... The F111 and its internal organs are a “radical effective departure” from any contemporary aircraft. The supersonic plane is the shape of things to come ...’<sup>126</sup> Fairhall’s answer came some months later, but shed no further light on the matter as no aircraft had been recovered at the time.<sup>127</sup> However, the lingering question remained: Had Australia bought a ‘lemon’?

The implications were not lost on the British press either. The USAF F-111 losses followed shortly after both the USN and RAF orders had been cancelled and according to the editor of *The Journal of the Air League*, ‘the F-111 now seems suspect’. The editorial went on to question ‘will it do the job for which it is intended?’ and ‘can enough of the [F-111s] be obtained to constitute an effective force?’<sup>128</sup> It would be some time before the RAAF could provide the answers.

Investigations into the cause of the USAF losses focused on either TFR problems flying the aircraft into the ground, or on a jamming of the horizontal tail servo actuator (HTSA) mechanism. Crews had told investigators that some of their brethren distrusted the automatic TFR system which, when linked to the autopilot, automatically flew the aircraft over terrain and other obstacles. Lack of experience on type and a natural suspicion of aircraft computers meant many were manually interpreting the radar picture and hand flying the aircraft, possibly leading to their disaster, especially at night. While the TFR issue was never fully resolved, the HTSA problem was quickly rectified as mentioned previously.<sup>129</sup>

Two squadrons of USAF F-111s (48 aircraft) returned to Takhli and Vietnam in September 1972 under Operation *Constant Guard V*, a part of the *Linebacker I* and *II* operations. Despite aircraft

performance and survivability being exceptional, in fact better than all types in theatre, the loss of another eight aircraft reignited debate. *Time* magazine led the attack, quoting Wisconsin Senator William Proxmire’s charge in Congress that the ‘F-111 has often proved to be a death trap to its crews’ and ‘the mysterious disappearance of yet another F-111 makes it appear that the Air Force is unnecessarily risking the lives of American pilots in unsafe and defective planes.’<sup>130</sup> Proxmire’s grandstanding, although totally incorrect, made good print and again, the aviation community had to come to the aircraft’s rescue.<sup>131</sup> The Commander of the 429th Tactical Fighter Squadron at Nellis AFB gave an extensive press briefing, which was widely reported and noted in the Australian Parliament.<sup>132</sup> His boss, Colonel William Nelson, commander of the 474th Tactical Fighter Wing, stated that by May 1973, the aircraft had logged over 4000 combat sorties losing just six aircraft, a loss rate of 0.15 per cent.<sup>133</sup> Total numbers aside, by the time the F-111s left Vietnam in 1973, they had lost only eight aircraft compared with 40 F-4 Phantoms during the same period—September 1972 to June 1973.<sup>134</sup> Again, the RAAF Air Staff closely monitored the aircraft’s performance and the final combat outcome.

### An Undeserved Poor Reputation

Finally, under a combination of all these ‘controversies’ was the reputation the aircraft unjustifiably earned for ‘unexplained’ crashes. Because of continual media ridicule and Congressional partisan politics, safety statistics and comparisons became a regular item in F-111 articles of the early 1970s, but these still did not silence the aircraft’s critics. However, the facts dispute the ‘safety failure’ epithet. By mid-1969, the F-111 had already achieved the best safety record of any Century Series fighter for flights during its development phase; and by the time 250 000 cumulative flight hours had been logged in 1973, 31 F-111s had been lost, still the lowest of all contemporary, albeit less complex, high-performance aircraft competitors.<sup>135</sup>

The contemporary Australian experience with the F-111 reinforces the excellent safety record of the aircraft. At the time of retirement, and after 37 years of continual operations, the RAAF had lost eight F-111s to accidents, five of them fatal, out of a total of 43 aircraft.<sup>136</sup> This equates to a loss rate of 0.5 per cent per annum, remarkably low given the complexity of the aircraft, the number of flying hours and the extreme flight operating regime. But regardless of the facts, by the time the F-111s were due for delivery, the Australian public had retained the impression that the aircraft was a ‘lemon’.

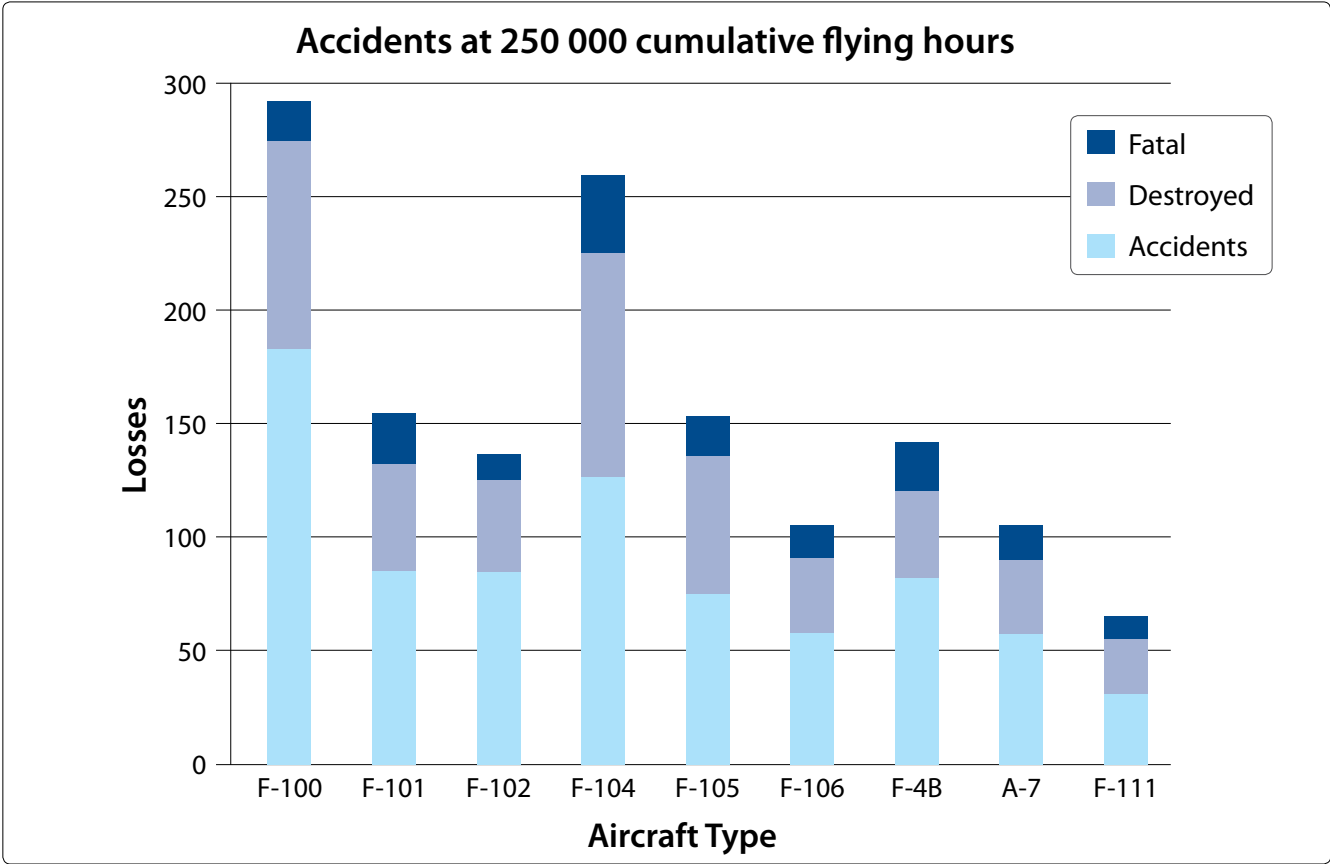
**The First Acceptance of the F-111C**

The horizontal stabiliser problem discovered after the 1968 fleet grounding was soon fixed by General Dynamics engineers and, together with several other modifications, was deemed by a RAAF investigation

team to be acceptable. The team, led by Air Vice-Marshall Ernie Hey, visited the US in May-June 1968 and reviewed both the engineering aspects and the aircraft losses to date. They were satisfied that a suitable remedy for the tail problem had been found and recommended to the Air Board that the Minister accept the aircraft, with the first to be delivered on 30 August and the last by 24 December that year.<sup>137</sup>

The first Australian aircraft to fly was A8-126 when it was taken for a shakedown flight from the General Dynamics factory on 13 July 1968, under the control of company test pilots, Dick Johnston and Jim Lucas, but it would be some time before Australia would receive the ownership certificate.<sup>138</sup> Still with nagging doubts about the safety and performance of the aircraft, the Australian Government agreed to accept them in September 1968, less than a month after the

**Figure 3–3: American Fighter Safety Record – 1964–1973**



Adapted from NAA: CRS A5931, CL253 – F-111 Aircraft for the RAAF



RAAF Museum

**Above**

The first Australian F-111 to fly, A8-126, taxis out for its first flight – 13 July 1968.

revised delivery date for the first aircraft announced in 1964.

The official acceptance took place at the General Dynamics main plant at Fort Worth, Texas on 4 September 1968 and was widely reported.<sup>139</sup> *Aircraft*, Australia’s leading aviation magazine, was quick to point out that the deliveries ‘add “muscle” to an elite RAAF’ and noted that for the first time the RAAF ‘possesses strategic as well as tactical striking power. What that means cannot be readily appreciated by the layman ... What is yet to be realised is the potency which a weapon of this type confers – politically as well as militarily – upon the nation possessing it.’<sup>140</sup> It was a grand affair with guests seated in front of a gleaming, first production F-111C, Serial No. A8-125, not realising it was really A8-131 with a temporary false tail number painted over the real number. F-111Cs 125, 126 and 127 were all in flight test, with 126 complete and ready

for handover to the Australian flight test crew, and the other three in the final stages of acceptance. A8-131 was the only fully assembled aircraft that was available for the formalities. Air Vice-Marshall Dave Rogers witnessed the occasion:

Leading the Australian VIPs were the Minister for Defence, Mr. Allen Fairhall, and the CAS, Air Marshal Alister Murdoch. The US Secretary of the Air Force, Dr Harold Brown, the USAF Chief of Staff, General John P. McConnell and a host of GD and other executives headed the American team. All the initial speakers referred to the aircraft by its commonly-used name, the ‘F-one-eleven’. Much to the embarrassment of all the Australians and amusement of others, Minister Fairhall repeatedly referred to the aircraft as the ‘F-one-double-one’ during his speech. One wonders where he and his minders had been for the last five years! General McConnell recovered the situation very tactfully when he later said in a jocular tone that the aircraft had had a lot of names and a chequered history, but it was still a ‘damn fine aircraft’!<sup>141</sup>

The assembled multitude was unaware that during the week before, on 27 August, the WCTB assembly undergoing fatigue testing at the General Dynamics



plant in San Diego had experienced a catastrophic failure under relatively low 4 g loading, a break point much earlier than expected and well below the predicted ‘life’ of the specimen. One aircraft ‘life’ was deemed to be 4000 hours, but USAF and Australian engineers required a minimum of 16 000 hours or four ‘lifetimes’.<sup>142</sup> The failure was initially kept very quiet, but it caused great concern and delayed all further acceptances until a fix could be found.

The Department of Air was advised of the failure on 29 August 1968, but the acceptance went ahead. Either the communications broke down, or no-one thought it important enough to inform the

Minister and cancel the official acceptance signing. Technically, ‘fatigue test article A4 had failed on 27 August at a very low number of loading cycles and stress level, indicating a very limited flying hour life’.<sup>143</sup> The failure was a disaster and, yet again, threatened the whole program, USAF aircraft included. The problem appeared to come from the properties of a new aircraft alloy called D6ac steel. When the TFX design was first proposed, the USAF, NASA and General Dynamics examined a range of materials that had an extremely high strength-to-weight ratio. By 1964, they had agreed that D6ac steel would meet requirements, so it was chosen for six critical sections of the F-111 aircraft structure.<sup>144</sup>

**What’s in a Name?**

Up till official acceptance in 1968, the aircraft had been called by various names, including F-one hundred and eleven, F-one-one-one, F-triple-one and F-one-eleven. While the RAAF had considered names for the aircraft such as *Taipan*, *Arkana* (Aboriginal for boomerang), *Bindana* (thunder), *Bilara* (spear) and *Galawindi* (firestick), like the USAF, no name was ever allotted.<sup>145</sup> The Air Board Proceedings of 20 September 1966 considered naming the aircraft with a plethora of options put forward, none of which saw the light of day. These included *Annihilator*, *Destroyer* and *Falcon*, and at least 18 Aboriginal names for various weapons of war. No name stood out, and the Air Board in its wisdom concluded ‘... that the name F-111 itself has a certain amount of appeal, enhanced to a good extent by usage. It is for question, therefore, whether a popular name would find much acceptance unless it were extremely appropriate’.<sup>146</sup> The F-111 was the only aircraft in USAF history that was never given a name while in service, a fact corrected on its retirement in July 1996, when the USAF called it *Aardvark* (an Afrikaans name for a South African ruminant, meaning ‘earth pig’). Although *Aardvark* had been used in USAF circles well before, much earlier, it had earned the less than endearing colloquial name by which it is generally known—‘the Pig’—giving voice to the 1966 Air Board comment.

The Australian term ‘Pig’ for the F-111 has several possible origins as well as the *Aardvark* translation. It is usually claimed to be called ‘the Pig’ because it has a long snout, spends most of its time rummaging in the dirt and is active at night. The terms ‘Aardvark’ and ‘the Pig’ were already in use in Australia in 1975, so may also have come from the term ‘pigs might fly’ after the aircraft’s troubles and constant grounding. The exact origin remains a mystery. The USAF held an official naming ceremony of their ‘Aardvarks’ when the last four F-111Fs returned to their birthplace on 27 July 1996—Lockheed Martin Tactical Aircraft Systems, Fort Worth. Neither was the F-111 the first RAAF aircraft to earn the epithet ‘Pig’. The Lockheed Ventura flown by No 464 Squadron, RAAF in Europe in 1942–43 was also called ‘the Pig’ by its crews for its allegedly porcine appearance, but strangely, also as a term of endearment. However, for those who were closely associated with the aircraft, it will always be remembered as the ‘F-one-eleven’.



82 Wing

**Above**  
Australian Ambassador Sir Keith Waller at the official acceptance ceremony.

However, as well as being extremely strong, D6ac steel was later found to be very brittle, with tensile stress failures occurring with little pre-failure warning.

Complicating matters further was a crash of another F-111A at Nellis on 23 September that resulted in the USAF again grounding the fleet the next day. Aboard the ill-fated aircraft was a USN pilot, Lieutenant John Nash, and an Australian exchange navigator, Flight Lieutenant Neil Pollock. The crew successfully ejected but the accident made news as it was the second time in the year that the aircraft had been grounded.<sup>147</sup> Although the crash was unrelated

to fatigue problems and solely aircrew error, the Australian media concluded the loss was the result of the continuing F-111 problems, and raised yet more questions about the entire F-111 program. The crash forced the Minister for Air, Gordon Freeth, to make a statement that Australia would not take the aircraft until all problems were fixed.<sup>148</sup> While it later transpired that the aircraft had lost control due to incorrect fuel management by the crew, the USAF was not taking further chances, and the precautionary grounding was extended until the cause was known.

After the Air Board had considered the implications of the fatigue failure of the WCTB in San Diego, A8-126, which had since been flown to Edwards AFB for range trials, was grounded along with the rest of the US and Australian F-111 fleets. Plans to ferry the aircraft across the Pacific were immediately put on



Above

A8-126 during its inaugural flight showing the original underside nuclear flash paint scheme.

hold. The suspension of the project became a cause for national concern with new questions asked about the continued viability of the program.<sup>149</sup> RAAF Resident Engineer at the SPO, Squadron Leader Bill Collins, later recalled:

The effort to address what had caused the failure in the fatigue test article became an ongoing saga, because as the fatigue test article was torn down, more areas were found where failures were starting. An Engineering Change Proposal, which had the number 2222, went through any number of revisions as more and more corrective action was taken.<sup>150</sup>

So began a series of investigations and considerations that were reported weekly to the Air Board by the Air Member for Technical Services, Air Vice-Marshal Ernie Hey. Most disturbing was the fact that the F-111 was designed under a ‘safe life’ concept, with each critical component expected to last well beyond a calculated number of flying hours before the aircraft were retired. As testing continued, further specimens began to fail around the 4000-hour mark at various settings of wingsweep or ‘g’ loading.<sup>151</sup> The first Australian F-111 at Edwards AFB remained grounded, aircrew and ground crew that had completed their training were told to return immediately to Australia and those still undergoing courses were to finish them and then return home.

Notes

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Professor Hugh White, interview, 6 May 2010. White is Professor of Strategic Studies at the Australian National University.

2

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‘TFX Named Canberra Replacement’, in *RAAF News*, vol. 5, no. 10, November, 1963, p. 1.

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The bomber numbers were Liberator – 287; Lincoln – 73; Canberra – 48; and Phantom and F-111 – 24. RAAF Queanbeyan Records Section, file A8/1/6, 6 May 1965.

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Peter Edwards and Gregory Pemberton, *Crises and Commitments: The Politics and Diplomacy of Australia’s Involvement in Southeast Asian Conflicts 1948–1965*, Allen & Unwin, North Sydney, 1992, p. 285.

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*Adelaide Advertiser*, 16 November 1963; *The Canberra Times*, 16 November 1963; *The Sydney Morning Herald*, 16 November 1963; and *Sunday Telegraph*, 17 November 1963.

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Australian War Memorial, S01657, Hancock interview transcript, p. 66.

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Air Marshal David Evans, interview, 5 December 2008.

18

OAFH, Annex A to Air Board Agendum 13034, 24 January 1964.

19

NAA: Series M2568, Item No. 56, Personal Papers of Prime Minister Holt, 12–31 March 1964; and Stewart Wilson, *Vulcan, Boeing B-47 & B-52*, Aerospace Publications, Fyshwick, ACT, 1997, p. 104.

20

OAFH, Air Board Agendum 13046, 10 April 1964.

21

Donald S. Stewart, ‘Phantom 2 ... A multi-role weapons system for USA’s pre-TFX needs’, in *Aircraft*, vol. 43, no. 5, February 1964, pp. 18–20.

22

‘Eight Points Defence Plan’ and ‘No B47; F111 in ’68’, in *RAAF News*, vol. 6, no. 6, July 1964, pp. 1 and 3; OAFH, Air Board Agendum 13083, 4 December 1964. See also Parnell and Boughton, *Flypast*, p. 306. The Wewak airfield construction project was intended to support F-111A operations against a hostile Indonesia, but budget constraints forced a deferral of the project after £150 000 had been expended.

23

Air Vice-Marshal Ian Sutherland, personal correspondence, 8 July 2008.

24

‘F-111A Roll Out is Threshold to New Dimensions of Flight’, in *Air Force Policy Letters for Commanders*, no. 12, November 1964; and ‘General Dynamics F-111: First of a New Generation’, in *Air Pictorial*, vol. 28, no. 1, January 1966.

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RAAF aircraft maintenance was conducted by Maintenance Squadrons and Aircraft Depots. The Maintenance Squadrons managed smaller, less complex servicings generally completed within weeks while the Depots did major servicings and repairs which often took many months.

26

‘Amberley has its first equipment for F-111 Training’, in *Courier Mail*, 9 February 1968, p. 5; ‘F-111 hangar at Amberley’, in *The Courier Mail*, 26 March 1968; and Parnell and Boughton, *Flypast*, p. 306.

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OAFH, Air Vice-Marshal Bill Collins, RAAF Oral History Program interview, November 2007.

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Scott MacDonald, ‘The F-111B: Can it do the Navy job?’, in *Armed Forces Management*, vol. 13, no. 3, December 1966.

30

‘Another “Swing-wing” Plane Urged as a substitute for F-111’, in *New York Times*, 13 July 1966, p. 13.

31

George C. Wilson, ‘McClellan to Resume F-111 Investigation’, in *Aviation Week & Space Technology*, vol. 85, no. 8, 22 August 1966, pp. 16–17; and James P. Stevenson, *The Pentagon Paradox: The Development of the F-18 Hornet*, Naval Institute Press, Annapolis, MD, 1993, chap. 2 (pp. 51–61) covers the full story.

32

The Senate Armed Services Committee Congressional Budget Hearings of March 1968. The Congress afterwards cancelled funds to the F-111B. Quoted in ‘Tests & Testimony’, in *Time*, 22 March 1968. See also ‘Air Admiral



Hails F-111B an Easy Plane to Fly’, in *New York Times*, 2 June 1967, p. 26, where Connolly lauds the aircraft.

33 ‘VFX-1 – Successor to the F-111B’, in *Aerospace International*, September-October 1968, pp. 22–24; David Baker, ‘Feline Claws: The nine lives of the F-14’, in *Air International*, vol. 49, no. 5, November 1995, p. 286; ‘The F-111B – White Hope or White Elephant’, in *Armed Forces Management*, vol. 13, no. 10, July 1967; Richard Witkin, ‘Why the Flak around the F-111’, in *The New York Times Magazine*, 2 April 1967; U.S. Congress, Senate, Ninety-first Congress, second session; Committee on Government Operations, *TFX Contract Investigation (Second Series)*, 1970, p. 75; and David Baker, *Grumman F-14 Tomcat*, The Crowood Press, Marlborough, 1998 cover the F-14 development history.

34 Air Vice-Marshal Dave Rogers, interview, 17 July 2008.

35 Lawrence R. Benson, *Acquisition Management in the United States Air Force and its Predecessors*, Air Force History and Museums Program, Washington, DC, 1997, pp. 31–32. Air Force Logistics Command was renamed to become Air Force Material Command in 1991; Group Captain Spitzkowsky, correspondence.

36 ‘The AFPRO Story’, in *111 Log*, vol. 3, no. 5, September/October 1969, p. 9; and Group Captain Milt Cottee, interview, 9 July 2008.

37 ‘Air Force Logistics Command’, in *111 Log*, vol. 3, no. 4, July/August 1968, p. 18. SMAMA would eventually become SMALC – Sacramento Air Logistics Center.

38 OAFH, Air Board Agendum 13133, 12 November 1965. These included a Wing Commander Equipment Officer – Pentagon, two Squadron Leader Equipment Officers – GD/FW and SMAMA, and two Squadron Leader Engineers – SPO and GD/FW.

39 Air Vice-Marshal Sutherland, correspondence.

40 OAFH, Group Captain Colin Spitzkowsky, interview, 21 November 2007; and author, interview, 11 October 2008.

41 OAFH, Air Vice-Marshal Collins, interview, November 2007.

42 OAFH, CASAC Agendum 29/80; and CASAC 33/80 (Talbot Report).

43 These include: 1986 – Dibb Review; 1989 – Wrigley Review; 1991 – Force Structure Review (FSR); 1992 – Australia’s Strategic Planning in the 1990s (ASP90); and 1997 – Defence Reform Program (DRP).

44 The TF30 was the world’s first afterburning turbofan engine.

45 There are a considerable number of articles on this theme.

46 ‘The F-111: Act of Faith’, in *The Bulletin*, vol. 90, no. 4622, p. 20.

47 OAFH, Air Board Agendum 55/69 – Revised F-111C Project Status Report, April 1969.

48 OAFH, Air Board Proceedings, 12 June 1964, p. 56.

49 Val Prael, ‘Flight Test Report – F-111’, presented at the Society of Experimental Test Pilots Symposium, Beverly Hilton, Beverly Hills, CA on 24 September 1965. Prael was the F-111 right-hand seat pilot, Dick Johnson was General Dynamics chief test pilot and captain for the flight. Also ‘Status of F-111 Programs’, in *Air Force Policy Letters for Commanders*, no. 5, May 1966, pp. 26–27 summarises the flight test activity.

50 This letter contract specified 407 F-111As and 24 F-111Bs over the US 1965–68 budget cycle. OAFH, Air Board Agendum 55/69. A new formal contract (AF33 (657) – 13403) for 493 aircraft was signed on 5 May 1967. ‘Take off for the F-111’, in *Time*, 19 May 1967, p. 65.

51 The first F-111C (A8-125) was intended to be production number 92 with the 24 aircraft to be built between production numbers 84 and 113. Delays forced a change to this. The RAAF eventually got the odd production numbers between 121 and 155 inclusive for the first 18 F-111C, and numbers 156–161 for the remainder. OAFH, Air Board Agendum 90/68, 11 October 1968; and 55/69, April 1969.

52 *ARL Annual Report 1967–68*, Department of Supply, 1968, p. 10.

53 Air Vice-Marshal Dunlop recalled the original design was to meet the USAF specification for radar cross-sectional area. Moving the intake out resulted in a stronger radar return, and thus a greater radar signature for enemy radars. Air Vice-Marshal Dave Dunlop, interview, 2 September 2009 and correspondence.

54 Air Vice-Marshal Dunlop, interview, 9 October 2009 and correspondence.

55 Coulam, *Illusions of Choice*, pp. 72–77 and ch. IV; Cecil Brownlow, ‘Mk. 2 Hits Severe Cost Problems’, in *Aviation Week & Space Technology*, vol. 90, no. 9, 3 March 1969, pp. 16–17; and Claude Witze, ‘The F-111’s Mark II Avionics System – Weapon Effectiveness or Electronic Gadget?’, in *Air Force & Space Digest*, vol. 52, no. 8, August 1969, pp. 62–65.

56 F-111A, Serial No. 63-9773, a pre-production aircraft and the eighth built. As a pre-production aircraft, it had problems with under-performance and was not liked by the fighter pilots or test pilots. George J. Marrett, *Contrails Over the Mojave: The Golden Age of Jet Flight Testing at Edwards Air Force Base*, Naval Institute Press, Annapolis, MD, 2008, pp. 129–133. US flight testing is conducted in three phases or ‘categories’. Cat I – Contractor testing and shake down at the production facility; Cat II – the USAF check on performance, handling, weapons and systems (usually done at Edwards AFB by test pilots); and Cat III – USAF operational evaluation by the user, in this case, TAC.

57 ‘Report on April Meeting’ (Speaker: Mr Harry Walton), in *Aeronews*, Royal Aeronautical Society, Canberra, May 2009, p. 2.

58 Group Captain Ron Green, interview, 12 December 2008.

59 ‘Delay in F-111 Seen as Result of Crash’, in *New York Times*, 21 January 1967, p. 35.

60 The first crash was F-111A (63-9774) on 19 January 1967, Green, interview.

61 J. Richard Elliot, ‘Point of No Return: The TFX Program has gone from Scandal to Disaster’, in *Barron’s National Business and Financial Weekly*, vol. 46, issue 33, 15 August 1966, pp. 1–5.

62 ‘F-111: Factual Errors, Misleading Conclusions’, in *Aircraft*, vol. 46, no. 1, October 1966, pp. 30–31 and 46; Griggs was the staff officer responsible for operational requirements for the bomber force and had done a month-long F-111 familiarisation course in August 1966. Minister for Air, Howson, flew an R&D aircraft at GD/FW on 5 October 1966. The flight had widespread TV and print media coverage.

63 John Fricker, ‘The People vs. the F-111’, in *Flying*, vol. 84, no. 5, May 1969, pp. S-1 to S-18. The charges were: 1. The TFX concept is completely invalid – Not Guilty; 2. The source selection was the result of ‘political considerations’ – Not Guilty; 3. Excessive cost escalation – Guilty, with mitigating circumstances; 4. F-111 suffers from excessive flight restrictions – Not Guilty; 5. F-111 is seriously deficient in safety and performance – Not Guilty; and 6. The F-111 is a flop operationally – Not Guilty.

64 Air Vice-Marshal W.E. Townsend, ‘F-111C Meets RAAF Needs’, in *RAAF News*, April 1968, p. 6; ‘F-111C – In the RAAF’, in *RAF Quarterly*, vol. 9, no. 1, Spring 1969, pp. 65–68; and ‘F-111C – All Weather Strike Potential’, in *Aircraft*, vol. 47, no. 12, September 1968, pp. 30–33.

65 ‘Spend \$151,365,282 ... and still save’, in *Queensland Times*, 8 March 1969; E.W. Tipping, ‘Deal for RAAF F111s in a Spin’, in *Brisbane Telegraph*, 12 May 1969; ‘Labor Attack on F-111’, in *Telegraph News Pictorial*, 5 March 1969; ‘Aust. Contract for F-111 Stands – But all options open’, in *The Queensland Times*, 29 May 1969; ‘New F-111 bug may mean end of deal’, in *The Courier Mail*, 2 July 1969; ‘Gorton calls urgent conference on F-111’, in *The Queensland Times*, 3 July 1969; ‘Gorton Acts on Latest fault in F-111, in *The Courier Mail*, 23 July, 1969; Harold Cox, ‘F-111 was a political weapon’, in *The Sunday Mail*, 1 June 1969; and John Atherton, ‘F111: Triumph or Flop?’, in *The Courier Mail*, 23 June 1969. There are many more!

66 After decimal currency was introduced in 1966, the Australian dollar was worth more than the US dollar by up to 1.25 to 1.

67 The gun was first tested in January 1967 on the fifth prototype (63-9770). Anthony M. Thornborough and Peter E. Davies, *F-111: Success in Action*, Arms and Armour Press, London, 1989, p. 21.

68 Air Board Agendum 62/71, 25 June 1971 – Acceptability of the F-111C to the Air Staff.

69 Air Vice-Marshal Rogers, interview, 6 May 2009 and correspondence.

70 The National Archives, UK: CAB 148/20 Series 30-34, 26 March 1965.

71 *ibid.*; and The National Archives, UK: CAB 148/19 Series 11, 13, 14; Cab 148/30/13; Cab 148/80/1; and Air Historical Branch (RAF): Air 20 11438 and Air 20 11920.

72 ‘Military Affairs: United Kingdom’, in *Flying Review International*, vol. 22, no. 10, June 1967, p. 614.

73 ‘Aircraft v. Hospitals’, in *Flight International*, vol. 91, no. 3035, 11 May 1967, Editorial; and Robert Blackburn, ‘The F-111K Censure Debate’, in *Flight International*, vol. 91, no. 3035, 11 May 1967, pp. 730 and 768–9. Refers to debates in the House of Commons, 1 May 1967 where Healey equated savings from TSR2 by buying F-111K/AFVG as £700m over 15 years—equivalent to 140 hospitals.

74 The National Archives, UK: Cab 148/30/13; and UK: Cab 148/80/1.

75 ‘U.S. Discloses U.K. F-111K Closeout Costs’, in *Armed Forces Management*, vol. 14, no. 11, August 1968, p. 34; Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S. 38, 17 September 1968, p. 705.

76 Bill Gunston, *Modern Fighting Aircraft 6: Panavia Tornado*, Ian Allen, London, 1980, pp. 10–14.

77 Air Vice-Marshal Stewart Menaul, *Countdown: Britain’s Strategic Nuclear Forces*, Robert Hale, London, 1980, p. 168.

78 ‘U.S. Extends Britain Option for F-111A’, in *Aviation Week & Space Technology*, vol. 83, no. 25, 20 December 1965, p. 23; and ‘Reorganised Commands and Major Withdrawals’ and ‘Costs and Standards of the F-111K’, in *Flight International*, vol. 91, no. 3024, 23 February 1967, pp. 299 and 301.

79 NAA: A1209, 1969/9011 Part 1, letter McNamara to Paltridge, 27 September 1965.

80 NAA: A5619, C40 Part 1, Cabinet Decision 1484, 19 January 1966, Cabinet Submission 1206 refers; and NAA: A5827, Volume 39/Agendum 1206.

81 NAA: A5827, Volume 39/Agendum 1206, 15 February 1966.

82 US Air Force Historical Research Agency (AFHRA): K 146.0034-72 – F-111 Program Cost Estimate – GD Fort Worth: RAAF/F-111 Program Funding Summary and Cost details, 1 June 1966, table, p. 17-1.

83 ‘RAAF F-111 Costs Rising Fast’, in *Flight International*, vol. 89, no. 2974, 10 March 1966, p. 366.



84 The FB-111As were designed for the Strategic Air Command whose concept of operations was to operate nuclear strike bombers deep into Soviet airspace. This required longer range—hence the longer wings—and the ability to operate from more rudimentary airstrips as found in Western Europe and at higher all up weight—hence heavier undercarriage to better absorb shock and support the weight. The FB-111s usually carried four underwing 600-gallon fuel tanks and nuclear weapons making the aircraft much heavier. The wings and undercarriage designed for the USN’s F-111B were therefore ideal for the FB-111. Graham Warwick, ‘F-111: Strike Fighter for the 1990s ?’, in *Flight International*, 9 January 1982, p. 67.

85 NAA: A5827, Volume 39/Agendum 1206, Cabinet Submission 217 of 27 May 1966; and Cabinet Decision 285, 1 June 1966.

86 OAFH, Air Board Proceedings, 27 October 1967.

87 These changes also included: addition of an HF radio; removable right-hand control stick; removal of weapons bay trapeze (for internal air-to-air missiles); Australian national markings, RAAF supplied survival kits; and ‘g’ meters. OAFH, Air Board Agendum 55/69.

88 To avoid confusion with models, the USAF renamed the RAAF and RAF models, hence F-111C and F-111K respectively. ‘New Plane’s Designation’, in *RAAF News*, vol. 9, no. 1, January-February 1967; and ‘F-111C Designation for RAAF’, in *Flight International*, vol. 90, no. 3014, 15 December 1966, p. 1045.

89 Group Captain Spitzkowsy, interview, 15 January 2009.

90 AFHRA: K 146.0034-72; and K 146.0034-77, 29 December 1966.

91 Initially by press release while Parliament was in recess. Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 51, 12 May 1966, p. 1769; ‘F-111 Bomber on Schedule’, in *RAAF News*, December 1965, p. 1; ‘Cost of F-111 bombers up 6pc to \$184m’, in *The Canberra Times*, 28 February 1966; ‘Australia’s Plane Costs Rise’, in *New York Times*, 28 February 1966, p. 24; ‘Sharp rise in F-111A price to Australia’, in *Financial Review*, 28 February 1966; and ‘There is still room for bargaining on F-111 deal’, in *Aircraft*, vol. 45, no. 7, April 1966, p. 13.

92 NAA: A5619, C40 Part 2, 4 May 1967. NAA: A5872, Item 124, gave the costs as US\$300m.

93 Peter Howson, *The Howson Diaries: The Life of Politics*, The Viking Press, Ringwood, 1984, p. 289.

94 ‘F-111 cost not hidden – Howson’, in *The Canberra Times*, Friday, 17 November 1967.

95 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 55, 3 May 1967, pp. 1644–1648.

96 U.S. Congress, Senate, Ninety-first Congress, second session; Committee on Government Operations, *TFX Contract Investigation (Second Series)*, 1970, Part 1, pp. 179–182; and Report No. 91-1496, 15 December 1970, pp. 78–82.

97 Cabinet Minute Decision No. 345, 14 March 1973.

98 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 118, 15 April 1980, p. 1758. Cost should be A\$11.56m per aircraft if the modifications are included.

99 *The Sydney Morning Herald*, 26 October 1963, p. 1.

100 ‘F-111A – An Introduction to the RAAF’s “Bomber”’, in *Aircraft*, vol. 44, no. 3, December 1964, p. 34.

101 For a full and technical explanation of fatigue testing see Dr A.O. Payne, ‘Reliability Approach to Structural Airworthiness’, in *Aircraft*, vol. 45, no. 1, October 1965, pp. 16–20.

102 The loss on 8 May 1968 of F-111A No. 66-0032 (aircraft No. 50) was almost identical to the loss on 30 March 1968 of F-111A No. 66-0017 (aircraft No. 35) over the Thai-Laos border. In the latter case the crew also ejected and survived. The failure was due to a ‘fracture of a lock weld allowing a rod end to unscrew itself in the dual-phase control valve assembly providing primary control of the main hydraulic actuators for the horizontal stabilisers’. ‘F-111A Crash Cause Corrected’, in *Aircraft*, vol. 47, no. 11, August 1968, p. 38.

103 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 56, 21 September 1967, p. 1178; and ‘F-111 Deliveries, Training’, in *Aircraft*, vol. 47, no. 1, October 1967, p. 58.

104 The four instructors were sent over on 5 July 1967. They were pilots: Flight Lieutenants Ian Westmore and Ivan Skipworth, and navigators: Flight Lieutenants Neil McM. Pollock and Bob Bruce.

105 The four courses were No 1: 11 February – 6 November 1968; No 2: 23 March –13 November 1968; No 3: 4 May – 21 November 1968; and No 4: 15 June – 11 December 1968.

106 OAFH, Air Vice-Marshal Dave Rogers, transcript of interview. Rogers stated that only the first two courses went to Cannon, the last two going from Mather AFB directly to Nellis.

107 Air Vice-Marshal Rogers, interview.

108 Group Captain Ian Andrew, interview, 8 September 2008.

109 This included 94 officers and 432 airmen trained in both the US and Australia. Of these 53 were officer aircrew. The cost was US\$2.632m. ‘Training Comes High’, in *Aircraft*, vol. 48, no. 2, November 1968, p. 56.

110 Group Captain Greg Grantham, interview, 16 April 2009.

111 Air Vice-Marshal Sutherland, correspondence.

112 ‘USA News in Brief’, in *Flying Review International*, vol. 20, no. 10, June 1967, p. 615.

113 Circular Error Probable or CEP is a statistical term used for weapons accuracy. It means that 50 per cent or more of the bombs should fall within the given radius, in this case, 200 ft.

114 W. Howard Plunkett, ‘Radar Bombing during Rolling Thunder – Part 1 – Ryan’s Raiders’, in *Air Power History*, Spring 2006, p. 10.

115 ‘F-111s in Action’, in *RAAF News*, vol. 10, no. 3, April 1968, p. 1.

116 ‘Combat Lancer The F-111A’s Introduction to War’, <http://www.f-111.net/F-111A/Combat-Lancer-F-111As-Introduction-to-War.htm>, accessed 9 February 2009.

117 Howard W. Plunkett, ‘Radar Bombing during Combat Lancer and Commando Club’, in *Air Power History*, Summer 2006, p. 11. Present were General Ryan (COMPACAF), Lieutenant General Moore (USAF Inspector General), Lieutenant General Taylor (Commander Tactical Fighter Weapons Center, Nellis) and the Thai base commander, Colonel Vasharat.

118 OAFH, Air Board Proceedings, 4 December 1967, p. 242.

119 Chris Hobson, *Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed-Wing Aircraft Losses in Southeast Asia 1961 – 1973*, Midland Publishing, Hinckley, 2001, pp. 143 and 145–146. Losses were aircraft 66-0022 on 28 March 68 (wreckage never found and crew MIA, presumed killed), 66-0017 on 30 March 68 (flight controls jammed and crew ejected safely in Thai territory) and 66-0024 on 22 April 68 (believed flew into ground in TFR mode, crew MIA, presumed killed).

120 OAFH, Group Captain Col Spitzkowsky, Oral History Program interview, 21 November 2007; and author interviews, 11 October 2008 and 15 January 2009.

121 Wing Commander (later Air Vice-Marshal) Roy Frost had been appointed Commanding Officer of No 6 Squadron for the F-111 arrival in July 1968. He never took command due to F-111 project delays.

122 The attachments went from 19 March – 17 October 1968. The RAAF sent Roy Frost and Lyall Klaffer (fighter pilots with advanced weapons training), Eric Walker and Roy Collinson (navigators with advanced systems training), and Col Spitzkowsky, Joe Langlands and Arthur Skimin (engineers involved in the F-111 program).

123 Group Captain Arthur Skimin, correspondence, 24 July 2008.

124 Air Commodore Lyall Klaffer, correspondence, 14 September 2008.

125 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 58, 2 April 1968, p. 640. Requoted in ‘Not Just an Aircraft’, in *Aircraft*, vol. 47, no. 8, May 1968, p. 57; and again at Commonwealth of Australia,

*Parliamentary Debates – House of Representatives*, vol. 60, 15 August 1968, p. 216.

126 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 56, 22 August 1967, p. 276.

127 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 60, 17 September 1968, pp. 1074–1075.

128 David Dorrell (ed.), ‘The F-111 Lesson’, in *Air Pictorial: The Journal of the Air League*, vol. 30, no. 7, July 1968, p. 229.

129 ‘F-111A Performance in Vietnam Reviewed’, in *Aviation Week & Space Technology*, vol. 90, no. 5, 3 February 1969; and L.M. Bland, ‘USAF F-111 disaster in Vietnam’, in *Materials Australia*, May 2008.

130 ‘The F-111 Mystery’, in *Time*, 4 December 1972, p. 24; and Lou Drendel, *F-111 in Action*, Squadron/Signal Publications, Carrollton, TX, 1978, p. 27.

131 ‘F-111s Prove Worth in Southeast Asia’, in *Armed Forces Journal*, March 1973, pp. 22–23; Cecil Brownlow, ‘F-111 Shows Bombing Support Strength in Indochina’, in *Aviation Week & Space Technology*, vol. 98, no. 18, 30 April 1973, pp. 88–93; Wayne Thomis, ‘Whispering Death: The F-111 in SEA’, in *Air Force Magazine*, vol. 56, no. 6, June 1973, pp. 22–27; and Drendel, *F-111 in Action*, pp. 27–32 and copied as ‘F-111 Experiences in Vietnam’, in *Australian Aviation & Defence Review*, September 1979, pp. 64–69.

132 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 85, 20 September 1973, p. 1408. Question on Notice No. 480.

133 ‘How the F-111s performed in S-East Asia’, in *RAAF News*, May 1973, p. 2.

134 Hobson, *Vietnam Air Losses*, pp. 235-249; and AFHRA: *The F-111 in Southeast Asia September 1972 – January 1973*, HQ PACAF Checo/Corona Harvest Division, 21 February 1974.

135 See Fricker, ‘The People vs. the F-111’, p. S-11; Benjamin F. Schemmer, “‘I Like my Job’: An F-111 Crew Shows Why”, in *Armed Forces Journal*, May 1972, chart p. 35; Captain John Francis, ‘F-111: A Pilot’s View’, in *Air Force Magazine*, vol. 54, no. 4, April 1971, p. 32; and George Weiss, ‘The F-111: The Swing-Wing May Surprise You Yet’, in *Armed Forces Journal*, 19 July 1971, p. 23.

136 The RAAF initially ordered 24 aircraft, bought an additional four F-111As in 1980, and 15 F-111Gs in 1992, making a total of 43 aircraft.

137 OAFH, Air Board Agenda 47/68, 21 June 1968; and 51/68, 5 July 1968.

138 A8-126 was ready before the ‘first’ off the production line, A8-125. First flight details: Max altitude – 50 000 ft; Max speed – Mach 2.33; Sortie duration – 1.55; Time at supersonic speed – 11 minutes. Via Air Commodore Anker Brodersen.

- 139 This was 5 September 1968 in Australia as is sometimes recorded. 'Here it is!', in *RAAF News*, vol. 10, no. 8, September 1968, p. 1; and 'Australians Receive First F-111C', in *Air Force Policy Letters for Commanders*, October 1968.
- 140 Editorial: 'F-111C deliveries this month add "Muscle" to an elite RAAF', in *Aircraft*, vol. 47, no. 12, September 1968, p. 21.
- 141 Air Vice-Marshal Rogers, interview and correspondence.
- 142 OAFH, Annex A to Air Board Agendum 90/68, 11 October 1968. The exact number of equivalent flight hours could not be determined at that time.
- 143 OAFH, Air Board Agendum 86/68, 2 October 1968. The failure occurred at 7980 hours although it was expected to last until 18 000 hours.
- 144 These were the WCTB, the WPF, the FS496 air inlet bulkheads, the upper and lower longerons, the FS770 bulkhead, and the horizontal tail and rudder torque levers. All were primary load bearing components.
- 145 'How to Say F-111C', in *RAAF News*, vol. 10, no. 8, September 1968, p. 1. Peter E. Davies and Anthony M. Thornborough, *F-111 Aardvark*, Crowood Press, Marlborough, 1997, pp. 142–143. Taipan was Minister for Air, Peter Howson's choice. Howson, *The Howson Diaries: The Life of Politics*, p. 242. However, the Royal Air Force were 'cool' to Howson's proposal and likewise the RAF suggestions of Merlin and Richmond were also rejected. OAFH, Air Board Proceedings, 10 March 1967.
- 146 OAFH, 'Naming of the F-111s', Air Board Proceedings, 20 September 1966 and 10 March 1967. The Air Board in their 10 March 1967 Proceedings suggested F-one-hundred and eleven so as to not confuse it with the VIP jet, the BAC-111 then in service. The name never stuck.
- 147 F-111A Serial No. 66-0040 (aircraft No. 58). Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 60, 24 September 1968, p. 1359; and Richard Witkin, 'Air Force Temporarily Halts All Flights of F-111', in *New York Times*, 25 September 1968, p. 1.
- 148 'F-111A crew saved by ejection capsule', in *The Sydney Morning Herald*, 25 September 1968, p. 1; 'F-111 fact this week – US loses another', in *The Age*, 25 September 1968; and 'F-111 crash will delay delivery' and 'Won't take them until position is clear: Freeth', in *The Australian*, 25 September 1968, p. 1.
- 149 'No end of puzzles for John Gorton', in *The Bulletin*, vol. 90, no. 4620, 21 September 1968, p. 15; 'Cost to limit the F-111?', in *The Age*, 23 September 1968; 'News in Brief', in *Flying Review International*, vol. 24, no. 2, October 1968, p. 11; and 'F-111 Fatigue Problems, and Political Reactions, are Cause for Concern', in *Aircraft*, vol. 48, no. 1, October 1968, editorial, p. 15.
- 150 OAFH, Air Vice-Marshal Collins, RAAF Oral History Program interview, November 2007; and Collins, interview, 15 December 2009.
- 151 The F-111's wings could be swept fore-aft to an angle of between 26 and 72.5 degrees perpendicular to the fuselage. Each setting gave the aircraft different aerodynamic performance and was thus subject to different stresses. Likewise, a mass stationary on the earth's surface experiences a gravitational pull of 1 g. As the body accelerates in a vertical direction, it resists the force of gravity and, depending on how fast the acceleration, can pull any number of times the force of gravity. This extra loading on the wing also causes additional stresses.

# 4. ACQUISITION (PART II)

## 1968–1973

*The value of the Government's long-awaited defence statement last night was greatly diminished by the uncertainty surrounding the F-111. In no small sense it was Hamlet without a Prince.*

Editor, *The Sydney Morning Herald*<sup>1</sup>

### **The Wing Carry Through Box Crisis**

The USAF responded to the crisis by convening a Blue Ribbon Council to find a solution. The Council recommended inspection and rework of Taper-Lok holes, and the manufacture and installation of a plate to cover the entire problem section (using the 'fail safe' method). Taper-Lok was the trade name for the large tapered locking bolts that held major D6ac steel components together. The Council comprised about 20 senior members from General Dynamics, Air Force Materiel Laboratory (at Wright-Patterson AFB), the F-111 SPO, and several contractors. The Council was created in addition to an advisory group (which included members from industry, but not the manufacturer, General Dynamics) and an internal USAF group called the Ad Hoc Committee—a part of the USAF's Scientific Advisory Board.<sup>2</sup> The SAB, as it became known, set up extensive research and test programs across the USAF, NASA, industry and university laboratories to investigate the properties of D6ac steel and to confirm its suitability for aircraft use. Meanwhile, US Air Force Secretary Harold Brown had faith in a fix being found, and on 11 October 1968 he agreed to continue acceptance of the F-111A aircraft with unmodified wing boxes and place performance restrictions (essentially 'g' limits) on operations until the metal fatigue problem was remedied.<sup>3</sup> This bold decision saved the entire F-111 project from cancellation.

The RAAF responded by sending Air Commodore D.R. 'Jell' Cuming, a noted RAAF test pilot and aero engineer, over to see for himself and report back to

the Air Board. He was accompanied by Dr Alf Payne, Principal Research Scientist and a fatigue specialist from ARL, Melbourne (at the time, a part of the Department of Supply) and Laurie Bland, another ARL scientist. As well as sending experts over to the US, ARL formed a special Scientific Advisory Panel to support the RAAF and commenced a comprehensive assessment of F-111C fatigue life under expected Australian conditions.<sup>4</sup>

Concomitant with the arrival of Cuming, Payne and Bland in 1968 was a decision to replace the then Project Manager, Group Captain Sam Dallywater, who had succeeded 'Spud' Spurgeon, with Group Captain Milt Cottee, a test pilot with some experience of metal fatigue. To his surprise, Cottee found he and his small team were independent, as the RAAF Air Attaché in Washington and Air Staff in Australia had very little involvement, despite the crisis. Apart from Air Vice-Marshal Hey, who had become the de facto project manager in Canberra, few in Australia realised the complexity of the project, nor the number of issues that had to be resolved. Cottee's main contact was with the USAF through the Foreign Military Sales Office and with the other Australian F-111 project staff scattered across the US. He later recalled:

There was extreme, hectic and continuous pressure from all directions and mostly at the highest engineering level. I soon learned that the best results could be achieved for the program by referring problems to the highest USAF level. My calls to two-



and three-star generals always had a magic effect. At its peak, I was even taking weekly calls from a staffer of the President who wished to be kept advised of the Aussie program.<sup>5</sup>

As well as managing the RAAF F-111 Project Office, Cottee also became a member of the US Scientific Advisory Board, able to report on developments

**Below**  
RAAF aircraft in production at the General Dynamics plant.

**Opposite, top**  
Group Captain Milt Cottee, the third and final F-111 Project Manager.

**Opposite, bottom**  
The RAAF's F-111s in store at GD/FW.

as they came to hand. He remained the RAAF Project Manager for five years until the aircraft were delivered.

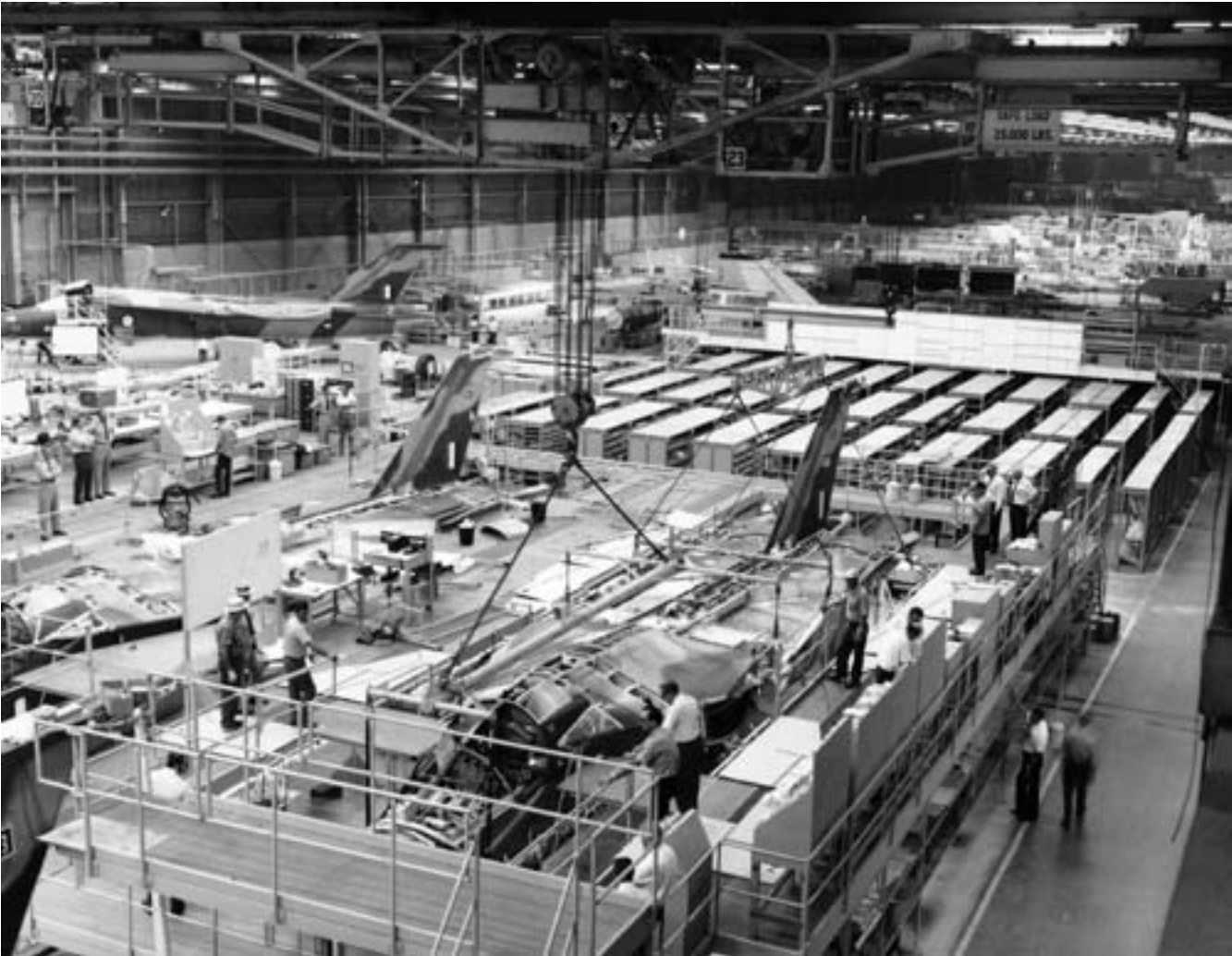
The next step was to work out a fix for the WCTB problem, then organise repair work and, once cleared for flight, accept the aircraft a second time. All this would take time and additional funds, so after further negotiations with General Dynamics, the 24 Australian F-111s were placed into protective storage. After being inhibited for preservation and having their engines removed, all were squeezed nose to tail into a spare hangar at Carswell AFB across the aerodrome from the GD/FW plant and left there.

While it was pure gold to the Labor Opposition, news of the delays caused the Government further

consternation.<sup>6</sup> However, political intent when in opposition is clearly very different to when in government. In late 1968, and after his removal as Minister for Air, Peter Howson found he was still debating the merits of the F-111 with the national media over the aircraft's grounding. On one occasion, he appeared on Barry Jones' TV program, *Encounter*, with Gough Whitlam as his protagonist. While Howson claimed the debate went well despite being attacked at every opportunity, he quietly asked Whitlam afterwards a simple question: Would he, if he became Prime Minister, cancel the [F-111] order? According to Howson, Whitlam indicated he would 'certainly do no such a thing.'<sup>7</sup> Commenting later on the Whitlam approach, former Defence Minister, Kim Beazley stated: 'Well Gough was of course an airman and he was an airman of the type that the F-111 would appeal to because it was fought by a navigator and that's what he was. It was his view of the appropriate status in fighting terms!'<sup>8</sup>



RAAF Museum



Cottee



RAAF Museum



**Flight Trials Placed on Hold**

Formal Ministerial acceptance in September 1968 was supposed to herald the start of the flight trials of the Australian-unique model to confirm the aircraft's performance and flying characteristics. Test pilot, Squadron Leader Ron Green, and flight test engineer, Harry Walton, signed for F-111C serial A8-126 from Wing Commander Tony Dietz at GD/ FW, on 5 September 1968 and flew it to Edwards AFB to commence the trials work. According to Green, a full RAAF maintenance team was already in place at Edwards to support these tests, with the intention being to conduct range trials at Edwards to determine just what range performance the longer wing would provide. The Australians wanted to ferry

**Below**

Steve summed up how most felt about the non-existent aircraft. *The Mirror*, May 17, 1970.



"He's my F-111. Not what I bargained for but I can't get out of the deal."

the aircraft back across the Pacific, and the trials would show if it could be done unrefuelled by air.<sup>9</sup>

However, upon arrival at Edwards, Green was given an urgent message to call a rather agitated Group Captain Sam Dallywater, the RAAF F-111 Project Manager in Washington, and told the aircraft were all grounded. He explained about the WCTB failure on the test rig and mentioned the possible cancellation of the project, not the least the legal implications of Australia having accepted the aircraft. Green would have to wait and see what transpired.

Consequently, when the October trade magazines hit the newsstands, the problem-plagued aircraft was well and truly back in the media spotlight.<sup>10</sup> The Opposition was not slow on the uptake either. Both the Deputy Leader of the Opposition, Lance Barnard, and Opposition Leader Gough Whitlam, requested the tabling of all documents associated

with the purchase. Leader of the Democratic Labour Party, Senator Vince Gair, followed suit, calling for all documents related to the purchase to be tabled in the Senate, regardless of classification or sensitivity.<sup>11</sup> The request caused the Treasury, and Departments of Air, Defence and Attorney-General to work through five tons of documents to see which could be released.<sup>12</sup> In the end, Prime Minister Gorton read a statement to the House stating he would not breach national security to satisfy the Senate's demands, but he did seek US approval to release financial details.<sup>13</sup> However, Gorton eventually provided some other documentation, citing classification and US releasability as the reason much was missing.<sup>14</sup> Barnard was seeking to embarrass the Government and pressed for a full explanation in Parliament noting, 'Despite the inadequacies of the documents tabled, it is possible to gain a clearer perspective of the whole F111 project which has lurched crazily from mishap to mishap'.<sup>15</sup> Meanwhile, Barnard had also taken the opportunity to write a short treatise called 'Australian Defence'. In it, he stated: 'At the time of writing [January 1969], the future of the F-111 weapons system is clouded. Even if it becomes part of the defence structure, it is difficult to visualise a tactical situation in which a \$6 million aircraft could be risked. In short, the Air Force is not equipped to provide support required in a limited war or counter-insurgency operation'.<sup>16</sup> The arguments continued.

After a two week hiatus, the RAAF Project Manager gave approval for a taxi excursion of A8-126 at Edwards once each week until a decision was made on the future of the aircraft. This approval was given after concern was passed to Washington over the deterioration of seals in the hydraulic systems due to lack of pressure because of lack of use. According to Green, the RAAF contingent quickly became known as 'the owners of the fastest go-kart on the West Coast of USA'.<sup>17</sup> By early November 1968, approval was received to return A8-126 to Fort Worth, so on 14 November, Green and Walton flew the aircraft back to Texas, but took the liberty of conducting a

further functional check flight on the way, gathering a good deal of range performance data. On arrival, the aircraft was parked with the rest of the grounded Australian fleet.

**Fatigue Studies and ARL**

One of the main issues immediately apparent after the WCTB fracture was the dearth of knowledge about metal fatigue in the F-111, and the properties of ultra-high strength steels such as D6ac. Until the mid-1950s, the US and UK manufacturers did not have to worry too much about fatigue or corrosion, since aircraft usually entered service for a few years and were retired or replaced well before problems became apparent. Additionally, steel and aluminium metal components had well-defined properties and the idea of 'safe life' or 'fail safe' construction avoided unexpected in-service failures. D6ac steel was different. It had been developed by the Republic Steel Company in the US and was produced for General Dynamics by the Ladish Steel Company to exacting standards and was rated at 210 000 pounds per square inch (that is, one square inch of material could support over 100 tons in tension).<sup>18</sup> Although the original idea was to use titanium, an extremely strong and lightweight metal for critical structures such as the WCTB and wing pivot fittings, its hardness made it difficult to machine precisely and its cost was prohibitive. This was one reason why the Boeing TFX design was considered higher risk, as it had a large percentage of titanium structure to help meet the USN's lower all-up-weight requirement. Combining with the unknown properties of D6ac steel under extended load were the limitations of the non-destructive testing and inspection techniques and a poor understanding of fatigue life estimation, fracture mechanics, crack growth and reliability theory at that time. Problems were also compounded by seemingly ad hoc changes made during the Super Weight Improvement Program instituted by General Dynamics, intended to reduce the weight of the aircraft for the USN.<sup>19</sup>



It was at this time that the Aeronautical Research Laboratories (ARL) in Melbourne came to the fore. Scientists and engineers had been working on fatigue problems since World War II and had developed significant expertise—so much so that they surprised the American engineers at General Dynamics when the ARL team arrived in 1968. In the 1950s, and as well as similar work, ARL scientists and engineers had tested 222 surplus P-51 Mustang wings under a variety of load conditions. It was (and remains) one of the most extensive testing regimes of any aircraft wing structure, intended to see how the wings performed under stresses that were experienced in flight.<sup>20</sup> Later work on Vampire, Lincoln, Canberra and Mirage aircraft added to this experience. The data gave ARL a significant understanding of metal fatigue in aircraft structures and allowed Dr Alf Payne and others to be quickly accepted in America as fatigue experts.<sup>21</sup>

Back in Melbourne, ARL had prepared detailed materials and structures test programs, including

**Below**

Geoff Hook's comment on fatigue life. *The Sun* 3 July 1969.

**Opposite**

Squadron Leader Col Spitzkowsky inspects rework on an F-111. The WCTB can clearly be seen.

the production of a test rig, designed to provide data on the fatigue properties and fracture mechanics of crack growth of D6ac steel and other like materials.<sup>22</sup> Consequently, for the next three years, Materials and Structures Divisions of ARL provided almost continuous support to the F-111 project.

The RAAF was seeking a 15-year life from its aircraft to 100 per cent of the design flight load spectrum. That meant a 'safe life' figure of around 4000 hours and a requirement to test to 16 000 hrs or four safe lives to allow for statistical 'scatter' in the test specimens. Unfortunately, a WCTB under test at General Dynamics failed after a very short period of testing equivalent to about 200 hours of flying time, or a safe life of just 50 hours, well short of the desired life and that predicted by General Dynamics. After extensive examination, the cause was put down to poor manufacturing techniques and lack of quality control inspection by the subcontractors. Specifically, the failure arose from a combination of micro-cracks in the Taper-Lok holes propagating rapidly due to the stresses imposed, and imprecise fitting of the Taper-Loks in the holes in the components they were meant to secure.<sup>23</sup> Once these cracks began to propagate, they did so very quickly, to the extent that a 1000-kg WCTB could literally, and very rapidly, break in half. F-111 Project Manager at the time, Group Captain Milt Cottee, explained:

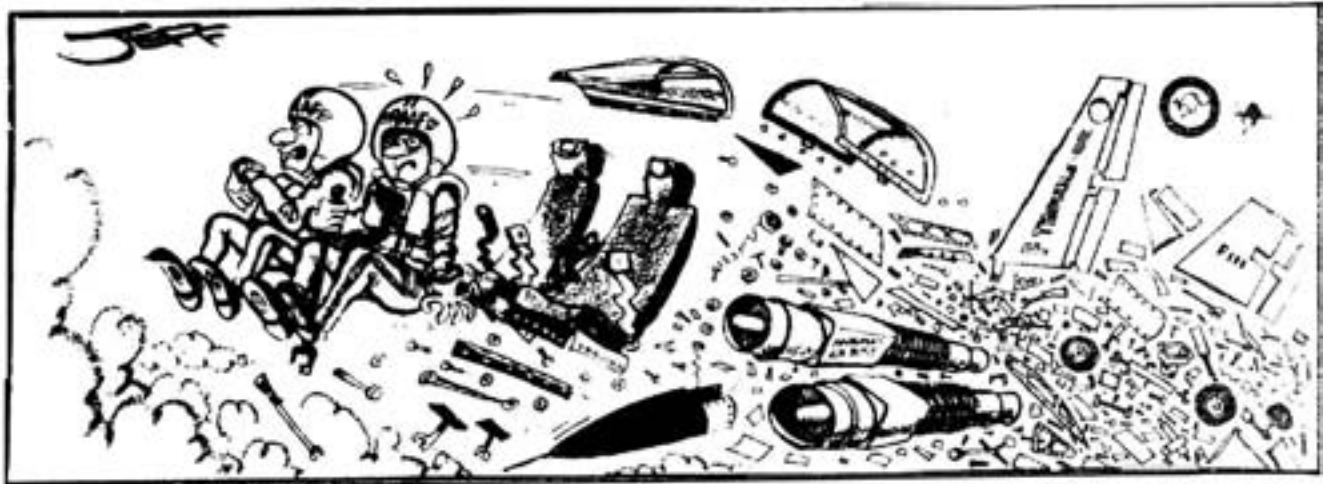
[D6ac steel] had to be treated with the greatest care and respect. The sensitivity of the material was not fully appreciated initially, and failures of early WCTBs resulted from roughness in the tapered holes containing the fasteners. The holes were finished with four fluted reamers which left residual irregularities. All such holes had to be refinished with eight fluted reamers and [each one] individually mated with its Taper-Lok, carefully torqued into each hole.<sup>24</sup>

The ARL team at General Dynamics reported on a weekly basis. It was Payne who was able to keep the Air Board informed (through Air Vice-Marshal Ernie Hey – Air Member for Technical Services) and he who raised the possibility that the fault was due to poor manufacture tolerances in the drill holes.<sup>25</sup> In a series of Confidential priority messages, Payne recommended full inspection of all the Taper-Lok bolts and rework be carried out before further acceptance. Together with Payne,

Laurie Bland, another ARL metals specialist who had been sent over to assist, kept a close eye on General Dynamics developments. The pair also found that not everything they wanted to report was palatable, particularly when being critical of General Dynamics staff, so they occasionally resorted to handwritten air mail letters which were then posted locally, thereby avoiding the official mail system. This was both simple and effective. Upon their arrival at ARL, the letters were reviewed and subsequently placed on a classified file away from view.<sup>26</sup>

In an article for *Aircraft* magazine, GD/FW Division President Frank W. Davis later explained the fatigue testing concept:

The carry through box and the centre section of the fuselage are mounted in a test rig with hydraulic rams attached to the dummy wings. The spectrum of bending loads or forces is applied to the wings by the rams.





These forces, some of which go beyond any allowable flight condition, are repeatedly applied at various wing sweep positions. The application of these forces many thousands of times represents one full lifetime of airplane usage under all expected conditions. To provide added confidence in the test results a ‘scatter factor’ is applied. A scatter factor of two would result in the above full life test being repeated twice, while a scatter factor of four would cause it to be repeated four times. Therefore when the carry through box completes the equivalent of four full lives it will have had a total of 43,480 bending forces, or cycles, applied to it. A scatter factor of four (the equivalent of 16,000 hours of flight time) is an extremely severe test that was [eventually] agreed to by GD and the USAF in the aircraft specifications.<sup>27</sup>

Fortunately, the next, now modified test specimen, failed at 18 000 hours, 2000 hours beyond that planned. The solution appeared to be as Payne had recommended; inspection and rework of the Taper-Lok holes, fitment of a gusset plate and strict observance of the appropriate specifications at manufacture. All appeared well. By April 1969, the Minister was calling for a full report on the issue and this was provided by Cuming and Payne to the Air Board on 2 May. Their recommendation was not to accept any further F-111Cs until all testing and issues with the WCTB were fully resolved—a wise decision.<sup>28</sup> It was also through ARL involvement that during 1969, the USAF agreed to supply 14 representative D6ac structures for testing in Australia. These were called ‘Humphrie’ or ‘Humphries’ Specimens after the General Dynamics design engineer who produced the detailed design work. Each was basically a steel slug to which were bolted aluminium alloy side plates representative of some of the F-111 design features. To do the testing, DSTO had to construct a 500 000-lb ‘Humphries’ fatigue-testing machine which was assembled in record time and soon put to good use making the contribution of DSTO scientists to the F-111 program more than significant.<sup>29</sup>

However, after further work to remedy the WCTB construction flaws, another redesigned WCTB

specimen (called FW2) commenced testing in the US on 7 June 1969, but within a fortnight, it too had failed. Again, rapid crack propagation was the cause and again, Cuming, Payne and Bland, together with Fred Hooke (a principal research scientist from the Life of Aircraft Structures Group, ARL) were dispatched to GD/FW. Here they joined the project team, Wing Commander Tony Dietz, the RAAF resident engineer, and Doug Glanvill (ARL senior technical officer) who was a non-destructive inspection specialist working on a new General Dynamics developed inspection process called Magnetic Rubber Inspection (MRI). This second major failure precipitated a whole series of further tests with at least five new specimens and modifications designed to rectify the fault. Again, the tests appeared successful and so confident were the engineers that they had fixed the problem that the USAF Scientific Advisory Board disbanded after presenting its third report in late 1969.<sup>30</sup> The WCTB testing was completed by mid-1972. Eventually, General Dynamics tested an F-111C WCTB to 32 000 hours and an F-111A WCTB to 40 000 hours, thus more than satisfying the engineers and a full refit of the new boxes commenced.<sup>31</sup>

Meanwhile, there was much discussion that the original test regime had been too ambitious and that subsequent tests should be conducted under less severe loads, but this would result in a reduced flight envelope for the aircraft. The report recommended a flight restriction to 80 per cent of design envelope until a formal WCTB retrofit to the entire F-111 fleet could be completed. ARL and the RAAF reluctantly agreed and, after further Australian Government urging, recommended to accept the aircraft in early 1970 on the proviso that the WCTB problem was actually fixed. Laurie Bland later noted that ‘there was, at this juncture, no openly expressed great concern with, nor acknowledgement of – other than by Boeing personnel ... – the impossibility of improving the fracture toughness of the steel ... without drastic disassembly and re-heat treatment of the W.C.T.B.’<sup>32</sup> He recalled:

Interestingly, and ironically, in the light of what occurred on that December day, and in the weeks and months (and years) that followed, the only party prior to December 1969 to consistently, and at times vociferously, express serious concern about the proneness of the material of the F-111 W.C.T.B. to brittle fracture in certain circumstances was a small group of materials scientists and design engineers from the Boeing Company. This group had been invited by the U.S.A.F. to observe the investigations by G.D./F.W. of the F-111 structural problems. Also, it is to be recalled, it was the Boeing Company that General Dynamics controversially defeated in the early 1960s for the contract for the provision to the U.S.A.F., and others, of an advanced, high performance tactical and strategic strike aircraft.<sup>33</sup>

It appeared to the ARL scientists and the RAAF that, while the USAF might be content with reworked WCTBs being fitted only for future builds, Australia should (and did) insist on new, higher quality boxes to be retrofitted to the RAAF fleet, and at USAF expense.<sup>34</sup> The F-111C fleet thus later received redesigned F-111F WCTBs, but the four F-111As acquired in 1982 did not.

### The F-111C Flight Simulator

Despite delays with the aircraft, the first major piece of new equipment acquired with the F-111 project was an aircrew flying simulator. Following the return of A8-126 to GD/FW, Green was dispatched to the Singer-Link simulator company in Binghamton, New York, to conduct the acceptance testing on the new F-111C simulator. It was simulator number five off the production line and while it had motion, it had none of the modern simulator accessories—no visual displays and no Australian land mass simulator to practice radar and TFR interpretation. It also employed the same software as the first four F-111A simulators, with no adjustment for performance of the Australian aircraft, because no empirical flight data was then available. Despite its lack of full fidelity, it was the RAAF’s first motion simulator and was needed to see the crews through the long wait for the aircraft.



RAAF Museum

**Above**  
The F-111C simulator as delivered.

Green ‘flew’ the simulator, and after a number of fixes, accepted it for the RAAF.<sup>35</sup> The simulator was then transported to Amberley and installed in the new F-111 training facility. Although a number of attempts were made to delay the simulator delivery to align it with aircraft delivery, the grounding of the aircraft defeated the purpose.<sup>36</sup> Squadron Leader Ian Westmore (acting on behalf of the USAF) and an American navigator did the acceptance tests in March and April 1969, and the simulator was cleared for RAAF use. The simulator went on to good use in keeping crews current in F-111 procedures while they waited to accept the aircraft.

### The 1969 Bland Mission

After another battering in Parliament over the growing number of technical problems and schedule delays, the Government announced in August 1969 that yet another high-level mission would be sent to the United States for discussions with their American counterparts.<sup>37</sup> This time, the Opposition labelled the aircraft the ‘F-trouble one’.<sup>38</sup> The team was headed by Sir Henry Bland, the Secretary of the Department of Defence, and included the Chief of the Air Staff, Air Marshal Alister Murdoch, the Chief Defence





Grantham

**Above**  
USAF Simulator training team with Flight Lieutenants Ian Westmore and Bernie Johnson and Squadron Leader Greg Grantham – 28 March 1969.

**Opposite, left**  
Sir Henry Bland conducted a major F-111 project review.

**Opposite, right**  
Gorton was ‘chained’ to the F-111 deal – *The Sun*, 9 April 1968.

Scientist, Henry Wills, Secretary of the Department of Air, Fred Green, and the Air Member for Technical Services, Air Vice-Marshal Ernie Hey. The team visit was again supported by Cuming, Payne and Laurie Bland.

The international media quickly picked up on the grounding saga with *Flight International* headlining

‘Australia’s F-111 Concern’ and *Armed Forces Management* asking ‘Will Australia Cancel F-111C Buy?’<sup>39</sup> The media’s angle related to the failure of a number of WCTB tests at around half the General Dynamics promised 16 000 hours. This, the USAF claimed, was still equivalent to four lifetimes, so they felt no further testing was necessary. ARL scientists argued that because Australia’s F-111s had longer wings, the GD/USAF calculations did not apply. The RAAF wanted 15 years life out of the aircraft under the extant test regime; however, it now appeared the aircraft would only last for about two and a half years in service with normal rates of flying.

The Bland team’s instructions were to examine uncertainties over the size of the USAF F-111 fleet, in particular the number of F-111As (the more built the better for Australia), the status of the reconnaissance version, the WCTB issue and the avionics to be used.



Defence PR

After extensive discussions with the Americans, their report was submitted to Cabinet in September 1969. The team had received assurances that the necessary fixes to the WCTB and ‘all future corrections of deficiency modifications in our F-111C aircraft’ would be incorporated into the Australian F-111Cs ‘at no increase in the ceiling price [US\$5.95m]’. It recommended taking delivery of the aircraft and deferring any consideration of the reconnaissance capability until the USAF had finally decided on their reconnaissance configuration.

The report’s findings were up-beat and Cabinet therefore focused on the main problem—the WCTB failure and its remedy. There was broad uncertainty about the status of a new WCTB commissioned by the USAF and whether it would be satisfactory and, according to Cabinet, this ‘presented the principal difficulty standing in the way of Australia taking the F.111s.’<sup>40</sup> Cabinet also noted there was no suitable alternative to the F-111, so Ministers put aside any



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discussion on project cancellation pending further testing of the WCTB due between October and November that year, and noted the lack of movement on the RF-111A design. A positive press release was issued with headlines such as ‘F-111 Pick is win for Military’ and ‘Credible Deterrent’, but this went against public opinion in the latest Gallup Poll, which was 62 per cent for cancelling the contract. What the poll did not consider, nor was the public made aware, was that contract cancellation was likely to cost a further US\$100m on top of the US\$183m already spent.<sup>41</sup> Subsequently, on 23 September 1969, Prime Minister John Gorton announced that subject to WCTB clearance, Australia would accept the aircraft.<sup>42</sup> Pending successful resolution of the issue, the ferrying of the repaired F-111Cs was planned to commence in May 1970, but the other worry was how long the ceiling price would hold good in respect of the rectification of deficiencies.<sup>43</sup>

The Bland mission was a clear sign the Government was saddled with a serious problem and had decided to wait it out. Gorton’s move on acceptance was particularly bold as he was facing an election in October 1969, but he was hoping the F-111 saga would not sway the voters against his Government. The fact that the US would guarantee the repairs at no additional cost would hopefully stifle criticism. His hunch was correct, although the Opposition Defence spokesman, Lance Barnard, stated that the Labor Party would renegotiate the whole deal, including replacement of the F-111s with a cheaper alternative if they got into power, although he did not specify which aircraft he had in mind.<sup>44</sup> Three days after the Gorton speech, the Senate carried a censure motion stating it considered the Government had mishandled the purchase, but Gorton was returned at the polls.<sup>45</sup>

It fell to Minister for Defence Malcolm Fraser to request on 5 December 1969 that the USAF reactivate the 24 F-111Cs held in storage so they could be taken over by the RAAF. A press release was issued stating the intention to ferry the aircraft to Australia, restrict the flight envelope to something benign, and await

a fix.<sup>46</sup> The crash of USAF F-111A 67-0049 later that month, however, suspended the request.

### Time for a Reassessment?

The grounding caused a reassessment of the need for the F-111 in the RAAF’s aircraft inventory. The threat from Indonesia that arose 10 years prior was no longer relevant and as the Vietnam War was nearing its end, the RAAF’s F-111s would not be called on to deploy in what was then the foreseeable future. The urgency to acquire the F-111 seemed no longer apparent, and the heat and noise generated in Parliament and by the media seemingly all went for cancellation. But the fact remained that unless Australia accepted the F-111s, it would not have an effective strike force for at least another 10 years. As the Secretary of the Department of Defence, Edwin Hicks,<sup>47</sup> was still questioning the project, the Air Board felt compelled to defend acquiring the F-111 rather than retain the Canberra bombers. The Air Board’s assessment of the Canberra strike capability was depressing in that it ‘is unable not only to make such a contribution to any allied effort in South East Asia, but is also incapable of providing any response to a situation directly threatening Australia or its Territories’. The assessment concluded that any threat to Australia ‘must come through Indonesia’, regardless of whether Indonesia was the aggressor or not.<sup>48</sup>

Furthermore, the deterrent value of the strike capability was stressed, even if it was never to be used. The paper noted the lead time involved in procuring a strike capability from scratch ‘is such that it cannot be left until the threat arises’. Given the pending UK withdrawal from South-East Asia, ‘a viable and credible deterrent is invaluable’. In balance, the paper also recognised that ‘in a permissive environment generally pertaining to a brushfire type of war, it would not be markedly more effective than any other tactical fighter aircraft’. The most effective feature was the F-111’s range, so the F-111 ‘should be kept as a deterrent and to carry out the strategic strike role should this be required’.<sup>49</sup>

### Disaster: The Crash of F-111A 67-0049

Just when General Dynamics, the USAF and the RAAF felt they were on top of the WCTB fatigue failure problem, another USAF F-111 crashed. F-111A 67-0049, the ninety-fourth aircraft off the production line (and from the same batch as Australia’s F-111Cs), lost its left wing during the pull-out from a rocketry dive at the Indian Springs range near Nellis AFB on 22 December 1969. The crew initiated ejection, but the aircraft was rolling and the module fired them straight into the ground. The all-American crew was killed. While it was only the fifteenth F-111 to crash in five years of flying, this aircraft had a new WCTB fitted, so the accident sent shockwaves through the USAF, General Dynamics and the RAAF hierarchies. However, upon investigation, it was found that it was not the WCTB that failed but the Wing Pivot Fitting (WPF), the part the wing swings around. The failure resulted from a flaw in the heavy forging of the WPF lower plate (see Figure 3–2, page 58) and, surprisingly, was initially assessed as ‘unique’ and a ‘rogue flaw’—with an extremely low probability of recurrence.<sup>50</sup> Again the fleet was grounded—the fifth time since April 1968. The accident went down as one of ‘the most significant material defects in aircraft structural history’ and after a remedy for the failure was found, altered the way all aircraft materials were inspected forever after.<sup>51</sup>

After the conclusion of the investigation in mid-January 1970, the US Defense Secretary, Melvin Laird, appeared on national television to defend ‘the F-111 mess’ that he as a Republican had inherited from the Democrats. When it became known that a metal fatigue crack growing from a manufacturing flaw was the cause, the US media went for the Pentagon. Headlines bemoaning the ‘Dissatisfied Customer’ and that ‘Laird faces decision on F-111 future’ again raised the spectre of project cancellation. The *New York Times* went as far to call the F-111 ‘one of the biggest white elephants in the Pentagon’s zoo of horrors ... the F-111 fighter-bomber, now estimated to have cost \$4 billion over

and above the original \$3.3 billion projection’.<sup>52</sup> However, of equal concern to the RAAF was a story that appeared in the *New York Times* two days later that the US Defense Department was cutting US\$1b from the next two fiscal years for the F-111 program, equivalent to axing 121 aircraft. It transpired the *Times* article was correct and the order of 161 F-111Fs was reduced to just 40 and that of the FB-111 down from 263 to 76.<sup>53</sup> Less aircraft meant higher unit cost.

Despite press speculation that the cuts to the F-111 program were because of the aircraft’s ‘failure’, it was really because Secretaries Laird and Seamans were pushing the Advanced Manned Strike Aircraft or AMSA, later called the B-1. One B-1 was intended to replace six FB-111s. Moreover, according to USAF Historian, Marcelle Knaack, the FB-111 was always intended to be a ‘stopgap airplane’ and was only accepted by the USAF as long as it did not jeopardise the AMSA program, so a cut to the FB-111 fleet was of little consequence to the American strategic bomber program.<sup>54</sup> The latest and final variant, the F-111F, only survived because two wings had already been allotted to NATO, to be based out of England as part of the USAF’s forward presence against the Soviet Union, and there was no other aircraft that could substitute.<sup>55</sup>

In the US, it appeared the whole testing, modification and rectification program would start again, causing yet further delays and cost escalation. Because of the gravity of the situation, ARL seconded Alan Patching (experimental officer, Structures Experiment Group) to GD/FW for two years to review fatigue tests, assist the General Dynamics engineers and monitor developments. The USAF Scientific Advisory Board Ad Hoc Committee reformed, and appointed Patching a special advisor. The RAAF Project Manager, now Group Captain Milt Cottee, the RAAF Resident Engineer at General Dynamics, Wing Commander Ted Whitehead, and the Project Engineer, Wing Commander Ian Sutherland, became invited observers. Laurie Bland and another DSTO scientist, Doug Glanvill, were sent to assist Patching



Spitzkowsky

**Above**

L-R: Wing Commander Ted Whitehead, Air Vice-Marshal Ernie Hey, Wing Commander Col Spitzkowsky and Wing Commander Ian Sutherland discuss repair work with a General Dynamics engineer.

**Opposite**

Mr Al Patching (left) and Wing Commander Ted Whitehead (centre) inspect magnetic rubber cast samples. with engineer from General Dynamics

at General Dynamics and the investigations began over again. Testing of a number of sample wing sections started almost immediately.

In Australia, the media picked up on their US counterparts' grim assessment that the project was shortly to be cancelled. The articles of derision came thick and fast.<sup>56</sup> The then Wing Commander Sutherland later recalled the tension this whole matter caused: 'I recall sending one of the team's reports of [test specimen] failures with a gloomy speculation of the USAF's reaction to more of these, indicating that perhaps the project might be cancelled. As this letter went to a great array of senior officers in Defence and even Foreign Affairs, I was shortly to receive a very caustic letter from my chief AMTS [Air Vice-Marshal Hey] telling me never to send anything like that again!'<sup>57</sup> Again, the Air Board went into damage control once the details had been forwarded, deciding to assess the data as it came in from the US on a monthly basis.

The work on the fractures went on not only in the US but also in Australia. Jerry Grandage was one who worked on the problem, recalling 'the RAAF were hell-bent on getting the aircraft into service as soon as possible' but 'the heat went out after the decision was made to not accept [the F-111s] at the time'.<sup>58</sup> This work on fatigue, done by DSTO in the late 1960s, later paid dividends in prolonging the service life of not only the F-111, but also the Macchi, Mirage and F/A-18 aircraft. The work DSTO did for the RAAF was invaluable.

**The 1970 Congressional Hearings**

The 22 December 1969 F-111A crash also reignited Congressional concerns and Congress decided to re-examine the F-111 program. Six years earlier, the TFX Contract Investigation hearings, which Senator McClellan had chaired, brought down no findings or recommendations despite 10 months of hearings and a 10-part, 2740-page report.<sup>59</sup> The Committee recessed after President Kennedy's assassination and the only questions asked late in the hearings in November of the Australian contract related to the amount of the periodic payments and whether the US approached Australia or vice versa.<sup>60</sup> While the F-111 aircraft was raised at each US budget session in a fiscal sense, no further in-depth analysis was done on capability, delivery or taxpayer value.

Subsequent to the apparent failure of the USAF's F-111s in Vietnam, and after further agitation by Senator William Proxmire, Senator McClellan agreed to reopen the investigation and hold a further series of hearings in 1970. The hearings commenced on 24 March and concluded on 28 April, and were eagerly watched by the media on both sides of the Pacific. As each hearing day was open to the public, the press covered the daily debate, selectively reporting the controversial testimonies. A second three-part, 678-page report was produced, with findings and conclusions and this time, released to the public uncensored.<sup>61</sup>

In their summary of proceedings, the Congressmen found that the F-111 program had been a \$7.8b failure producing about 500 aircraft of which only around 100 (the F-111F model) came close to meeting the original specification. The concept of forcing commonality on an aircraft that could not hope to meet both the USN and USAF requirements was flawed and over-management by bureaucrats was also heavily criticised.<sup>62</sup> The Australian media picked up on the statements by the Committee that the F-111 had been 'a fiscal blunder of the greatest magnitude' and 'a fiasco', and continued to deride the decision to accept the aircraft.<sup>63</sup> Nevertheless, and despite their goading, the program continued.

**The Development of New Techniques in Fracture Mechanics**

The USAF investigation into what caused the WPF to fail on the Nellis F-111A found that the failure followed fatigue crack growth from a manufacturing flaw in the lower plate of the fitting. The flaw was due to faulty forging. The extant Non-Destructive Inspection or NDI techniques were all found wanting, as small manufacturing flaws, inadequate inspection techniques and the fracture toughness of D6ac steel resulted in small critical crack sizes and meant a new technique had to be developed. This was agreed by Payne, Bland and Patching,



Patching

and the technique that emerged was to become known as Magnetic Rubber Inspection or MRI. The ultrasonic, X-ray scans and Magnetic Particle Inspection methods that had been used previously were unsatisfactory when it came to the D6ac steel problem.<sup>64</sup> In the MRI technique, originally developed by General Dynamics engineers in 1968, magnetised silicone rubber is injected into the sample and an electromagnetic force applied. Magnetised particles in the silicone migrate toward any defect and, after hardening, the magnetic rubber can be microscopically analysed to reveal any flaw.<sup>65</sup>

As well as the MRI technique, a new material known as Boron Fibre Reinforced Plastic showed promise as a design fix. By using a bonding material for stressed metal parts and as a construction material for control surfaces, these patches could spread the load and limit crack growth—using the 'fail safe' method.<sup>66</sup> Made into thin tape-like patches and glued onto the affected area, the doublers proved effective in restraining crack propagation and were used successfully to reinforce the lower plate of the WPF, the area that had caused the December 1969 crash. The application of the boron doubler was retrofitted to the entire F-111 fleet and the method was still used in 2010.

Thus, to remedy the myriad D6ac steel problems, a threefold plan was instituted. First, the WCTBs were replaced after application of a revised heat treatment regime for the D6ac steel and after more accurate reaming of the Taper-Lok holes. Second, a doubler of BFRF composite material was fitted to the underside each of the aircraft's two WPFs. Third, a full structural test program called Cold Proof Load Testing (CPLT) was instituted for each aircraft to ensure structural integrity and safety for flight. The CPLT program would be conducted every 2000 flying hours and would guarantee the aircraft was safe for flight for a further 2000 hours. As well as finding a remedy, the USAF adopted the Durability and Damage Tolerance Assessment (DADTA) principle based on the science of fracture mechanics after the 'safe life' principle had been found wanting. The



rectifications became known as the F-111 Structural Integrity Recovery Program (SIRP). In addition, the investigations and research into D6ac steel characteristics developed a new discipline called ‘Fracture Mechanics’—the understanding of how cracks in metals are transmitted and grow under alternating stresses. ARL and the RAAF were now considered among the pioneers of this science and the new era of fracture mechanics began.

**The Cold Proof Load Test Concept**

Although NDI and testing of samples in the lab under load were providing integrity checks on the manufacturing process, the question arose as to how the engineers could provide similar assurance that all areas of the critical structure had been cleared safe when many were inaccessible. Even small cracks could lead to sudden and catastrophic failure, so such detection was essential. How could an aircraft be 100 per cent guaranteed to reach its intended life? The other part of the problem was that often fatigue test results were not available early enough in the aircraft development phase, leading to costly rework when problems were eventually found.<sup>67</sup>

This problem of how to guarantee F-111 aircraft life vexed the Scientific Advisory Board until two Boeing representatives, William Gray supported by Charles Tiffany, raised the suggestion of cold proof testing the entire aircraft to qualify each aircraft as safe for flight. Tiffany and a colleague, J.N. Masters, had published an influential paper entitled ‘Applied Fracture Mechanics’ with the American Society for Testing Materials in 1965, and Boeing engineers were recognised as the fracture experts.<sup>68</sup>

The Boeing team’s thesis was that if an entire aircraft was subjected to representative flight loads under the worst possible simulated flight conditions and survived intact, then it would be safe for flying until any unfound cracks had grown to a critical length. This could be calculated using fracture mechanics theory. The D6ac steel was at its most brittle at  $-40^{\circ}\text{C}$  so testing at this temperature might reveal flaws

or minute cracks that could affect safety of flight. Their proposal was presented to the SAB and Cottee recalled the epiphany:

He, [Gray], emerged one morning following several days of session, to sow the germ of an idea to a conference room full of the world’s best aeronautical engineers. He said, ‘We all know that the critical crack length in D6ac steel decreases in length as temperature decreases. What we don’t know is how cold the aircraft primary steel structure gets in flight. If as I suspect, the structure does not cool significantly, then we have a means of proof testing the completed aircraft. All we have to do is cool the whole aircraft to, say, minus 40 degrees, and subject it to full flight load at that temperature. My preliminary calculations show that any internal undetected crack which does not become critical at the cold temperature will not become critical at flight temperature before several thousand hours of flight’. You could have heard a pin drop.<sup>69</sup>

The concept was to be applied after all other NDI inspection was complete and became known as Cold Proof Load Testing (CPLT) with ‘the basic objective to screen the structural system for defects including material flaws and any cracks not amenable to standard inspection practices’. A second objective was ‘to establish the inspection interval for the fleet in service.’<sup>70</sup> The untried concept appeared to have merit and involved building a large hangar, cooling it to  $-40^{\circ}\text{C}$  and subjecting the wings to hydraulic flexing to 100 per cent of the design limit load.<sup>71</sup> Proof loads of between  $+7.33\text{ g}$  and  $-2.4\text{ g}$  were applied at a wing sweep angle of 56 degrees in an effort to induce cracks. Later CPLT programs tested the wings at 26 degrees with negative ‘g’ loading lowered to  $-3.0\text{g}$ . A successful test confirmed the absence of any flaws above critical crack size and meant the aircraft was safe for flight for another 2000 airframe flying hours.

The concept was adopted because the only other option was to rebuild the WCTBs in titanium, a very expensive metal and hard to machine—something



Cottee

**Above**

An aircraft in CPLT – This time lapse photo showing the amount of wing flex.

that even the engineers baulked at, although it was seriously considered for a time.<sup>72</sup> In their usual way, the Americans quickly built four CPLT facilities, two at GD/FW, one at Waco, Texas, and one at SMAMA at McClellan AFB, Sacramento. The design, building and commissioning of the facilities and the testing of 325 USAF aircraft was achieved in an amazingly short time, between February 1970 and August 1971.<sup>73</sup> The technique worked and a regular CPLT regimen was instituted.

After delivery, the RAAF made formal arrangements with the USAF to conduct CPLT when required at the facility at McClellan AFB. This arrangement

remained in place until Lockheed Martin built a CPLT facility at Amberley in 2001, thereby ensuring the F-111C’s longevity after the USAF retired its fleet in 1996.

With flight restrictions in place, the USAF SAB cleared the F-111s for flight from 2 February 1970, an announcement that had a significant impact politically in Australia. Despite all the rumours that the RAAF would cancel the aircraft, the Government decided to rethink. *The Sydney Morning Herald* was not convinced and went as far in an editorial to call the aircraft ‘star-crossed’ and recommending Australia cut its losses, while *The Age* was more positive.<sup>74</sup>

The CPLT solution was not the end of the fatigue saga. A scandal had erupted after an FBI investigation into the Selb Manufacturing Company and Blades Manufacturing Company, both subcontractors



Whitehead

**Above**

A RAAF F-111 being positioned for CPLT. The hangar behind could be cooled to  $-40^{\circ}\text{C}$ .

producing parts for the WCTBs and fuselage longerons, also made from D6ac steel. General Dynamics raised initial concerns of corruption and the FBI laid charges against Harry Bass, the President of the Selb Company, and three others, alleging bribery of inspectors to pass their substandard products, falsifying serial numbers and for welding over cracks. Three General Dynamics employees were also implicated and General Dynamics filed a US\$3m suit for damages.<sup>75</sup> While Bass was later fined and jailed over the affair, the jury decided it could not directly link the poor quality manufacture with any of the accidents and there the matter ended.<sup>76</sup>

The Cold Proof program would eventually run until 2009 in four phases. First, there was the initial recovery program, which was conducted from 1970 at GD/FW. After the initial test and release to service, aircraft were again subject to the test as part of the USAF recommended Structural Inspection Program (SIP) that had also been adopted by the RAAF. These aircraft were tested at the Sacramento Air Logistics Center (SM-ALC) as they came due until 1983. RAAF F-111s were again tested at SM-ALC between 1989 and 1998. With the retirement of the USAF F-111 fleet, the CPLT facility was transferred to Amberley in 2001 and the final CPLTs were carried out there by Boeing. This regimen enabled the F-111 fleet to be operated safely until the end of their service life.

**The Fraser-Laird Agreement**

By early 1970 and despite all the good work being done by the engineers, it became apparent that the aircraft would be grounded for some time after the 1969 crash and, consequently, there would be a further delay in the F-111C's delivery. While the USAF could afford to be without the FB-111As for SAC and F-111s for TAC, Australia, politically, was not prepared to wait years for its F-111s. The Canberras were now facing significant fatigue problems and soon the three squadrons of 48 aircraft would be reduced to one operational squadron of 12, with the remaining aircraft retired.<sup>77</sup> Fortunately, the deployment to Vietnam was drawing to a close, and all Australian Canberras were home by mid-June 1971. The Government was again faced with the dilemma: accept the F-111 aircraft with a further lengthy delay, or cancel the entire program, potentially lose the US\$220m already spent, and look for a replacement.

Once the full implications of the crash had become clear, and the Government had received the initial reports of the in-flight failure of the WPF, it appeared that higher level discussions with the Americans would be necessary. Minister for Defence, Malcolm Fraser, proposed a visit to Washington to hold personal discussions with his counterpart, Melvin R. Laird. Fraser presented his case to Cabinet and pointed out the limitations of test techniques, the possibility of replacement of all WCTBs, and that the earliest an F-111C could be delivered was the first half of 1971. Fraser raised three redeeming factors:

- first, the USAF needed the aircraft in its inventory as a gap-filler between the F-4E and F-105 and the proposed Advanced Manned Strategic Aircraft—so they had to develop a fix;
- second, the US had previously agreed to incorporate all structural fixes for the Australian F-111s at their expense; and
- third, Australia faced no immediate threat, so time was on the Government's side.<sup>78</sup>

He then re-raised the option of F-4 Phantoms or possibly A-7 Corsair IIs (another US tactical bomber) being taken on loan during the interim, provided tankers were made available when required. The Australian press had already picked up on the seriousness of the wing failure, so Fraser was under immense pressure to deliver a solution—cancel or buy—but on the terms best for the nation.<sup>79</sup>

The editor of *The Sydney Morning Herald* echoed the public mood:

The value of the Government's long-awaited defence statement last night was greatly diminished by the uncertainty surrounding the F-111. In no small sense it was Hamlet without a Prince. Indeed, it can fairly be asked how the Government could possibly draw up a defence program without knowing whether or not one of its most vital elements would disappear overnight.<sup>80</sup>

According to Fraser's biographer, Philip Ayres, the mission would either make or break Fraser's reputation as a Minister and astute negotiator.<sup>81</sup> Fraser was accompanied by RAAF, Air and Defence Department personnel, and had in mind a four-point approach with which he would tackle the Americans. First, Fraser intended to get to the bottom of the F-111 problem and the implications for Australia. Second, he would probe for the latest information about the WCTB problem and the reconnaissance version. Third, he would probe the overall policy intentions of the Secretary of Defense, Melvin Laird, and Secretary of the Air Force, Robert Seamans, and the top echelons of the USAF. Lastly, he would indicate the Government's intention to explore the availability of alternatives 'against the contingency that the F111C could ultimately be found, in our view, not to meet the RAAF's requirements'.<sup>82</sup>

Cabinet approved the visit with the proviso that a press statement be released explaining the purpose of the visit, but 'to avoid creating the impression that the Government was contemplating cancellation of the contract or looking at an alternative aircraft'.<sup>83</sup>



Meanwhile, unbeknown to Fraser, Prime Minister Gorton privately wrote to President Nixon on 31 March asking him to ‘interest yourself in Australia’s situation’ and stating that a collapse of the deal would cast doubts on the capability of US aircraft manufacturers. Gorton went further to state that while supporting the US in Vietnam, Australia was carrying a gap in its defence capability— a situation at odds with Nixon’s Guam Doctrine. Nixon gave Gorton his assurances.<sup>84</sup>

Meanwhile, Fraser had been contemplating the broader defence issues raised by the F-111 dilemma. His personal notes dictated to his secretary recorded his concern:

In my mind, as we approach these discussions, is the gap still existing in the Australian force structure of the capacity represented in this aircraft. The RAAF should have a strike bomber capability. Also the [Vietnam] period and American reversal were militarily strategic in discussions particularly of the [policy] represented by the Nixon (or Guam) Doctrine. Under the Nixon Doctrine, American help will be more readily available to those countries that help themselves.<sup>85</sup>

On 3 April, Fraser led the delegation to the US. By now he was focusing on three main objectives. The first was to persuade the US that there were minimum performance criteria below which the aircraft would not be acceptable to Australia; second, to have it agreed by the US that in the event of the aircraft not reaching these performance criteria, financial responsibility lay with the United States Government; and third, to open options for the Australian Government concerning the need to equip the RAAF with a strike bomber capability.<sup>86</sup>

Fraser found the Americans harder to deal with than he expected. Fraser stressed to Laird the grave political embarrassment his party now faced after the wing failure and reiterated the role Australia continued to play in South-East Asia. The uncertainty and increasing regional turmoil meant Australia

‘needs an effective deterrent force for use on a regional basis’ and ‘in the absence of a deterrent, the situation would inevitably become less stable.’ Fraser ended by saying the need for F-111s was pressing and he hoped the pair could come to an equitable arrangement. His intended four-day stay stretched to 10 as the US negotiators, including Laird, stalled on the crucial points—performance and cost. Fortunately for Fraser, the McClellan Senate hearings were well underway, and Fraser used the threat to appear before the hearings to force an agreement.

Fraser’s mission was partially successful in that he got assurances that the problem would be fixed but he did not get any agreement on financial arrangements if the project failed.<sup>87</sup> To add insult, the Americans also wanted to include an additional US\$6.3m in ‘storage’ charges at GD/FW while the C-models were rectified.

As Fraser saw it, Australia now had five options:

- cancel F-111C without replacement;
- cancel F-111C and replace with F-4s, RF-4s and tankers;
- cancel F-111C and await the F-111F;
- store F-111Cs and await the Inspect and Repair as Necessary (IRAN) program (scheduled to begin in July 1972); or
- store F-111Cs, await IRAN and acquire an interim aircraft.<sup>88</sup>

Fraser clearly favoured the last option, especially as Laird offered Australia an interim lease of 24 F-4E Phantoms, with delivery from September 1970 under good financial arrangements. Laird counter-proposed three options: store the F-111Cs until rectified and lease 24 F-4Es, starting mid-1970; procure F-111Fs instead of the F-111Cs and lease 24 F-4Es as interim; or cancel the F-111Cs and replace them with F-4Es. Costs and pre-payments would be adjusted equitably.<sup>89</sup>

relatively modest, despite Opposition claims to the contrary.<sup>91</sup>

Of the baseball game, Fraser later stated that while they ate peanuts and shivered, ‘it was too damned cold to talk.’<sup>92</sup> Negotiations continued into the afternoon. In the end, Fraser achieved most of what he wanted, with the pair initialling Fraser’s single typed page of demands.<sup>93</sup>

The decisions made at that meeting decided the future of the F-111C. In the main, the agreement was that F-111C acceptance would be contingent on the aircraft meeting the specification, and the WCTBs would be replaced with a new design. Australia could cancel the deal within three months and receive partial reimbursement, and if the F-111s still failed to meet the specification, the US would buy back the aircraft for between \$130m and \$150m. A fleet of 24 Phantom aircraft would be leased in the interim. Cabinet subsequently agreed, with a RAAF mission to be dispatched to negotiate the F-4 lease and Fraser was directed to make a statement to Parliament to that effect.<sup>94</sup>

On 14 April 1970, Fraser and Laird signed off on the way ahead with a formal Memorandum of Agreement. The pair released a communiqué which summarised the main agenda items, although it was suitably vague. It stated that there was a necessary delay due the aircraft’s technical problems, so Australia would lease 24 F-4s for an interim period. Other options were discussed including aerial tanker support and its availability, but these were not elaborated.<sup>95</sup>

Tabled in Parliament on 12 May 1970, the full agreement laid out expectations of the structural integrity and operational performance of the aircraft, with the US to fund testing and repairs of the WCTB and WPF. Such repairs were reported to be of the order of US\$50–60m for the 400 aircraft already manufactured, with an additional \$30–40m required for the test procedures and ground rigs, including the Cold Proof Load Testing hangars.<sup>96</sup> While Fraser’s

The catch with all the F-4 options was that tanker support would likely be on an ‘as required by bid’ basis. In other words, US priorities would come first. On the matter of range and alliance commitments in South-East Asia, Fraser later pointed out that the F-4s could be deployed to Singapore or Butterworth by using transit airfields in Indonesia, the Philippines, Cocos Islands, or by in-flight refuelling. The cost would be A\$39m plus spares—a very attractive proposal, considering the F-111 predicament.<sup>90</sup>

Fraser was not alone on the mission. As well as his own entourage, he was supported by Group Captain Milt Cottee and the rest of the project team in the US. By now, Sir Arthur Tange was Secretary of the Defence Department and he accompanied the Minister together with Fred Green, the Secretary of the Department of Air, and Air Marshal Sir Colin Hannah, the Chief of the Air Staff. Tange in his memoirs later recalled the rather unorthodox negotiations between Fraser and Laird:

Fraser doubted that the Air Department’s conciliatory approach would give us satisfaction. He decided to go over the head of both Air Forces. He presented to Secretary of Defense, Melvin Laird, a largely political case about the damage to defence relations. He reminded the American that the Labor Opposition, who had attacked the transaction from the beginning, took a different view of our ANZUS association with the Americans. Fraser asked, in effect, that the Americans produce a viable aircraft or give us our money back. As Fraser himself has subsequently recorded, the venue of the negotiation shifted from the Pentagon to a stadium holding a baseball game that Laird wanted to watch. Perched on uncomfortable benches among shouting spectators, in an atmosphere redolent of hot dogs, the two negotiators went on with their business

After stressing the need for a viable aircraft in our joint strategic interests, Fraser accepted an offer to lease F-4 *Phantom* aircraft to bridge the gap until the F-111 problem was solved. Eventually we took delivery of this technologically advanced aircraft at a cost that was, in the context of rapidly rising prices,

stature as a statesman rose as it appeared he had personally negotiated the deal, the timing of Gorton’s direct appeal to Nixon can only have helped the mission’s success. Fraser returned satisfied, but the feeling around the RAAF was that the acceptability of the F-111 was at its lowest point.<sup>97</sup> To close off the debate, Fraser issued a press release in June explaining the Phantom lease and the expected delay to the F-111.<sup>98</sup> In later years, Fraser stated the F-111 negotiation was one of the toughest tasks he took on during his time as Minister for Defence, this despite the Gorton Government’s other troubles and public opposition to the Vietnam War.<sup>99</sup>

### The Read Mission and the Phantoms

After the F-111A wing failure prompted another delay, the Government agreed to Fraser’s recommendation to examine an interim aircraft, a proposal immediately supported by the Air Board.<sup>100</sup> Prior to the Board’s decision, the Blackburn Buccaneer, Vought A-7 Corsair II and the Grumman A-6 Intruder had also been looked at, but none came anywhere near the RAAF requirement. The F-4E Phantom II, the latest in the McDonnell Phantom blood line, appeared eminently more suitable, so it was mostly a ‘done deal’ and, not surprisingly, was unanimously recommended. Consequently, Air Vice-Marshal Charles Read, the Deputy Chief of the Air Staff, accompanied by seven others including Wing Commander Roy Frost, the Commanding Officer of No 6 Squadron, were dispatched to the US in May 1970 to coordinate the Phantom arrangement.<sup>101</sup> As they departed, the Air Board took the pre-emptive step of re-affirming that the F-111 ‘will meet the RAAF operational requirement more effectively than the F-4E by a decisive margin’, no doubt to stall any idea that the F-4s would make suitable F-111 replacements.<sup>102</sup> Air Vice-Marshal Read’s riding instructions were simple:

- To examine the offer of a lease of up to 24 F-4Es.
- To report on what arrangements would be necessary if the interim were required permanently.

- To examine the possibility of acquiring or leasing tanker aircraft.
- Investigate delivery, training and spares.
- Firm up cost estimates for the lease or purchase of the F-4Es together with tanker aircraft.<sup>103</sup>

Ironically, the F-4 option was first proposed in 1964 as an interim while the RAAF awaited delivery of the F-111, supposedly set down for 1968. The USAF’s F-4C had been a bomber contender and rejected by the Hancock team. By 1964, it was the F-4B and RF-4B, which had been operating successfully with the USN since 1960, that caught the RAAF’s attention. Additionally, Phantoms were also about to deploy to Vietnam with the USAF who had modified the USN version and initially called it the F-110 Spectre, a name that did not stick. By the latter stages of the Vietnam conflict, the F-4E model of the Phantom became available, but there was no reconnaissance fit, so the USAF continued to rely on the RF-4C.

While the Phantom had no TFR or internal ECM equipment, the Phantom’s real Achilles’ heel was its range limitation. It could deliver a bombload of 4000 lb out to a radius of action of just 450 nm. It meant that it could not deploy to Malaysia or Singapore without directly overflying Indonesia, but this limitation could be resolved by leasing USAF tankers, and such a constraint would only be for a few years. The capability gap would be the reconnaissance fit as no RF-4Cs were available.<sup>104</sup> The RAAF would have to make do with the Mirage with its single panoramic camera.

Cabinet approved the lease of the F-4E Phantoms with costs to amount to US\$41.554m for two years plus reparation for any losses, and a lease was formally signed in Washington on 29 June 1970. The Project was called *Peace Reef* by the USAF and included immediate spares, publications, training and provision of Field Service Representatives. A reconnaissance capability would again be deferred.<sup>105</sup>

As well as being a necessity, the Phantoms also enabled the RAAF to make a much smoother

transition to the F-111. As well as acting as an interim bomber, the F-4s bridged the technology gap between the Canberra and the F-111 nicely. The Australian F-4E Phantom II was a two-seat, multi-role combat aircraft capable of supersonic flight that could carry a range of air-to-air and air-to-ground stores. Unlike the Canberra, the Phantom had an inertial navigation system, a radar for air-to-air, a ground attack computer, and a gun.

The deal was quickly signed and the first Australian crews left in July 1970 for training and pick-up. Air Vice-Marshal Dave Rogers recalled the journey:

The first group of 10 pilots went to McDill AFB in Florida and 10 navigators to Davis-Monthan AFB in

Arizona for the transition (basic conversion) flying. All subsequent crews went directly to McDill where the 4530th Combat Crew Training Squadron carried out the training. We flew three dual rides in the F-4E then solo with the navs. All up, we did about 32 hours in the aircraft, which involved the transition, instrument and formation work; night check, intercepts, and air refuelling both day and night (the latter being new to most of us). The weapons side involved air-to-ground rocketry, gunnery with the Vulcan cannon, dive and skip bombing. It was a well-structured but demanding syllabus.<sup>106</sup>

The crews then went to St Louis to pick up their brand new aircraft. With USAF KC-135 tanker support, these were subsequently ferried to George AFB, California then to Hickam AFB, Hawaii, Andersen AFB on Guam, and into Amberley, the first group arriving on 14 September 1970.<sup>107</sup> The Phantoms were given the Australian aircraft prefix of

### Below

A flight of F-4s. Australia used these aircraft as interim bombers while awaiting the F-111.



RAAF Museum



‘A69’ for stores identification purposes, after the year of aircraft build and the USAF serial number prefix.<sup>108</sup>

The Phantoms were quickly incorporated into the RAAF’s Order of Battle (ORBAT) and served Australia well, so much so that many felt they should have been kept. In the end, only 23 aircraft returned (between late 1972 and mid-1973), one having been lost with its crew off Evans Head Air Weapons Range in June 1971.<sup>109</sup> The problem of payment for the missing aircraft was solved when the US Government agreed to write the Phantom off against an Australian P-3B Orion which had crashed and burnt in 1968 before acceptance in America. Given the cost differential, there is no doubt the US came away with the better deal.<sup>110</sup>

The Phantoms left the RAAF a lasting legacy. They were a perfect transition to the F-111 as they were two generations ahead of the Canberras. The crews had to learn how to operate a much more advanced weapons system than most had seen. There was a larger suite of weapons (including a gun and air-to-air missiles), crews could practise radar as well as

**Opposite**

Malcolm Fraser as Defence Minister visiting the crews for the F-4 arrival. Here shaking hands with Flight Lieutenant Kev Merrigan. 14 September 1970.



RAAF Museum

visual attacks, and the aircraft performance was far superior. Without the F-4s, many believed it would have been too large a step for the RAAF to bring the F-111s quickly into service and at least one senior officer agreed that, in RAAF service, the Phantom years ‘laid the foundations of a modern strike force.’<sup>111</sup>

**The Second Acceptance of the F-111C**

Despite all the Congressional brouhaha over crashes and metal fatigue, the CPLT technique was up and functioning and it appeared to be working. The USAF had only two failures in its 325 aircraft tested, and each would almost certainly have failed in flight, so lives were saved. Australia’s F-111Cs went into test in August 1971 with full refurbishment starting in April 1972. All aircraft were retrofitted with redesigned (new) WCTBs and boron doublers on the WPFs, and all passed the new NDI inspection and the CPLT process. This initial CPLT program was completed by the end of 1972. While testing their own WCTB and WPF specimens, ARL scientists discovered that the use of a cleaning solvent, Carbon Tetrachloride, during the manufacturing process was also causing corrosion fatigue—advice of which General Dynamics were initially sceptical, but once confirmed, led to a further change in manufacturing procedures at the Fort Worth plant.

A major outcome of the whole F-111 structure saga was a restriction on the authorised flight manoeuvre envelope required by the RAAF. The USAF SPO had previously agreed with General Dynamics in 1965 to a lower maximum ‘g’ figure, based on the F-111B (longer wing) configuration and stress predictions. Essentially, the amount of ‘g’ that can be pulled at a given weight is related to the wing strength, so aircraft all up weight (AUW) is critical in the calculation.<sup>112</sup> The SPO later confirmed that the contract was actually for only 90 per cent of that originally specified (and expected by the RAAF), because wind tunnel tests predicted the 100 per cent figure would greatly reduce aircraft life.<sup>113</sup> Because of the 90 per cent ruling, the 7.33 g upper limit of the USAF F-111A was reduced to a maximum of 6.5 g

**The Golden Anniversary Air Shows**

On 31 March 1971, the RAAF celebrated its Golden Jubilee. Formed in 1921 out of the remnants of the Australian Flying Corps, the RAAF is the world’s second oldest air force. From a cadre of just 151 men, including 21 officers, and 164 aircraft, the RAAF had grown impressively in strength and professionalism during its first 50 years.<sup>114</sup> To celebrate the grand occasion, a series of air shows were planned around Australia to which Marshal of the RAAF, His Royal Highness, The Prince Philip, Duke of Edinburgh was the guest of honour.<sup>115</sup>

To help support the shows, the USAF deployed four F-111As from the 430th Tactical Fighter Squadron, then based at Nellis.<sup>116</sup> The aircraft flew into Amberley on the RAAF’s birthday and immediately took all the attention, making F-111A, 67-0092, the first F-111 to reach Australian soil. While Lieutenant Colonel Bill Powers, the detachment commander, gave many positive press interviews, the media remained unkind, *The Age* going as far to headline ‘Lame-duck planes make first touchdown here’. *The Daily Telegraph* preferred to leave the question hanging: ‘Will RAAF fly its F-111 Jets?’<sup>117</sup> Even the professional aviation media gave the aircraft a lukewarm coverage. The Aviation Historical Society of Australia’s monthly journal recorded of the Fairbairn show:

The highlight was the arrival of the F-111 which was duly inspected by the politicians ... The F-111 display can only be described as woeful – wide circuits and high altitude passes ... With this participation there was also a very hard sell for the F-111 and Nimrod. Of these two promotions the F-111 appeared least successful – its display at Canberra was poor in relation to other aircraft and a much improved showing was made at Richmond. Here most spectators missed the best part of the display as the two departing aircraft rolled continuously while climbing into the sun. In fact, all the F-111 did well was make a lot of noise and was clearly a competitor with the Phantom in this field.<sup>118</sup>

It is likely the American crews were under orders to minimise risk of incidents. Regardless of the media opposition, the public were won over and the detachment was hailed a great success. What the public were unaware of was that 12 aircraft left Nellis to ensure that four would arrive in Australia.<sup>119</sup>



RAAF Museum

**The Non-Destructive Inspection Laboratory**

One outcome for the RAAF from all the work done on fatigue was the establishment by Air Vice-Marshal Hey of the RAAF Non-Destructive Inspection Standards Laboratory at RAAF Base Amberley in 1971. The requirement to regularly inspect the ultra-high strength steel components of aircraft like the F-111 meant the RAAF had to either develop its own testing and inspection system or contract the function out. Few in Australian industry had any experience with such materials so the only other option appeared to be industry in the US. This would have been both expensive and inconvenient, so the decision was made to do the work in-house. Under the Inspect and Repair as Necessary (IRAN) program—a safety-by-inspection program adopted by the USAF and the RAAF for fleet wide implementation—the concept of Non-Destructive Inspection (NDI) that the laboratory provided was the key to the early detection of flaws.

The laboratory was initially set up using expertise and training by ARL Materials Division staff and was in place before the first F-111 arrived in Australia. According to Air Vice-Marshal Rodney Noble, then Director General of Aircraft Engineering, the role of the laboratory was to ‘develop in-service NDI techniques based on ARL and other research overseas, using the latest equipment: eddy current, ultrasonics, X-ray, magnetic rubber and later, acoustic emission. Training of RAAF Fitters and the provision of a task force to supplement on-base expertise were included.’<sup>120</sup> The facility was a milestone in the development of NDI techniques in Australia and eventually was extended to cover Mirage, Macchi and F/A-18 before it succumbed to commercialisation in the 1990s.

for the F-111C, and then only for aircraft weights less than 59 000 lb—that is flying almost empty of fuel.

After detailed negotiations on what was an acceptable level of F-111C performance given the testing regimes and the engineer’s calculations, the original Air Staff Requirement of 6.5 g at 59 000 lb AUW was changed at the behest of the RAAF’s most senior engineer, Air Vice-Marshal Hey, to 4.0 g at 72 000 lb AUW. This was a more reasonable load spectrum for envisaged RAAF operations. It meant the RAAF’s aircraft could now be expected structurally to last the required 15 years or around 8000 flying hours. Although the fighter pilots among the crews complained as this limitation restricted aircraft manoeuvrability, there was little requirement to be able to ‘pull’ 6.5 g in a bomber aircraft that was designed to fly fast at low level and at night. It had also been agreed by the Air Staff in 1967 that air-to-ground rocketry and gunnery should be deleted from the training missions because ‘the F-111C would

not be employed in these roles operationally’ and that dive-bombing and evasive manoeuvre training should be reduced.<sup>121</sup> As a result, the F-111Cs were not expected to use the gun nor exceed 4 g in planned manoeuvres during training in peacetime anyway. Thus the ‘g’ restrictions agreed by the Air Board in 1972 allowed the aircraft to fly on for nearly 40 years.

As to longevity, in its (second) final report of October 1971, the USAF Scientific Advisory Board Ad Hoc Committee acknowledged that for the F-111, the standard ‘safe life’ calculations would no longer apply. Their final summary was telling. ‘The F-111 is capable of being a very effective weapon system for a long period of time. Because of certain unusual characteristics of the primary steel structure, however, the price of realizing this effectiveness is eternal vigilance on the part of all responsible for supervising, conducting and funding fleet



Cottee

**Above**

A General Dynamics company PR photograph to illustrate progress with A8-125.

operations, as well as the supporting inspection and maintenance.’<sup>122</sup>

After repair and retrofit of redesigned parts, the F-111 fleet would be a ‘structure for which Inspection, and Repair (or replacement) As Necessary (IRAN) was to be the basis for its continued safe operation’, and ARL’s Chief Defence Scientist, Dr John Farrands, who also attended the final SAB meeting, agreed.<sup>123</sup> IRAN had been a proven methodology in the USAF, being applied as

far back as the 1950s with the B-47 program, and was now considered the way of doing the maintenance business. The RAAF took a conservative approach to this and after delivery, instituted inspections to coincide with ‘E’ servicings, after about 600 flying hours or every two years.

In summary, the initial actions required to bring the F-111Cs back to airworthy condition were fitment of new WPFs and WCTBs and their associated tests, fitment of boron doublers and the gathering of technical assurance data.<sup>124</sup> However, the Modification/IRAN program which was due to commence in mid-late 1972 would cost an additional US\$35m to make the aircraft ‘as new’, costs that the USAF was forced to bear under the Fraser-



Laird agreement. As the second major modification and refurbishment program, it became known simply as Mod Refurb Two. As well as IRAN, the biggest benefit to the RAAF in the delays was the incorporation of over 50 other modifications which otherwise would have had to have been retrofitted at even greater expense and only possible during major aircraft servicings in Australia.

Having considered all the factors relating to the F-111's repair, the Chiefs of Staff Committee recommended acceptance of the aircraft at their 5 November 1971 meeting and noted the cost would now be \$330m.<sup>125</sup> By December, the structural test program embracing both static and fatigue tests for the USAF was complete and repair to the RAAF's aircraft was well underway. The USAF Scientific Advisory Board disbanded for a second time and, likewise, the ARL Scientific Advisory Panel to the RAAF.<sup>126</sup> With the reworked WCTB and regular inspections, the WCTB and WPF assembly had now been tested to 24 000 hrs and the critical fuselage components to 16 000 hrs or the 'four F-111C lifetimes' the RAAF insisted on.<sup>127</sup> All basic structures, including the wing, fuselage, vertical fin, horizontal stabilisers and landing gear, had been tested satisfactorily and the aircraft finally declared safe for flight. Consequently, the Minister for Defence, David Fairbairn, and Minister for Air, Senator Tom Drake-Brockman, both recommended Australia accept the aircraft and to release them for final modification starting in April 1972. Delivery would now commence from May 1973 and run through to September, and the leased F-4s would be returned to the USAF as soon as possible.<sup>128</sup> Cabinet approved, Fairbairn wrote to US Defense Secretary David Packard and a press release was issued on 16 December 1971 announcing the outcome, with the media immediately picking up the story.<sup>129</sup>

While many pundits claimed Australia should have just kept the F-4s rather than accept the F-111C, they were unaware of the real cost involved. Serious consideration was given by the Air Board to retaining the Phantoms, as well as to acquire the F-111, after

an offer from the USAF to do so. The Board reviewed the ability of the RAAF to manage both types and found that the up-front cost would be \$77m and that one Mirage squadron would have had to be disbanded immediately to release the necessary manpower.<sup>130</sup> Given Australia's growing commitment to the Five Power Defence Arrangements (FPDA) with two of the four Mirage squadrons in Malaysia, this was not possible. Furthermore, although the F-4s cost US\$39m, this was for lease fees, not a deposit, and the lease money had already been spent. To cancel the F-111s and acquire a 'full-up' force of 40 F-4Es (which included the 24 already in inventory) would have cost in excess of US\$650m not including tanker support—more than twice the sunk cost of the whole F-111 program.<sup>131</sup> Even so, the Air Board recommended retention of the 24 F-4s already in Australia, but the Government and Treasury were not convinced and the idea was abandoned.

With an end in sight to the problems that had plagued the F-111, apart from the more educated aviation media, only a very few reporters in the mainstream media were starting to come around.<sup>132</sup> Likewise too, the Air Staff were coming to realise they had to expand the role for their latest acquisition, bearing in mind the changed strategic circumstance since the original order in 1963. In a paper presented to the Air Board in June 1971 entitled 'Acceptability of the F-111C to the Air Staff', they argued the aircraft still met the original ASR with the exception of a slightly reduced radius of action and a lack of a reconnaissance role.<sup>133</sup> The aircraft would be accepted, but the main question remaining was how exactly would it be used.

It was a question the press asked too. Gavin Souter, writing in *The Sydney Morning Herald Weekend Magazine*, wrote:

Our two squadrons of F111s have cost nearly a third as much as the Snowy Mountains Hydro-Electric Scheme, and have almost taken as long to build as the Sydney Opera House. Now that such an electronic marvel has materialised, how many Australians

remember exactly what it is meant to do, and why we ordered it in the first place?<sup>134</sup>

Souter proffered a history lesson, but gave no answer to the contemporary question: what to do with them now? Neither could the Air Board, as the matter was apparently not discussed. Again, RAAF doctrine that might have been useful to explain the aircraft's utility in Australia's region of interest was notably absent.

### The RAAF Gets its F-111s

By March 1973, the Labor Party was in Government and Lance Barnard was Minister for Defence. Barnard was now responsible for the aircraft his party had been criticising for 10 years and also, regardless of ideology, he was bound by the decisions of his predecessor. When presented with the facts on sunk costs and technical progress, Barnard was forced to admit, 'I am convinced that we have no real alternative but to accept the aircraft.'<sup>135</sup> Cabinet, while noting their displeasure about the whole saga, agreed with Attorney-General, Senator Lionel Murphy, that Australia had little choice under the terms of the Fraser-Laird agreement and subsequently accepted the aircraft at a revised estimated cost of \$US324m. However, Cabinet could not resist a final jab and recorded 'its disapproval of the way in which the previous Government had conducted negotiations for the purchase.'<sup>136</sup> Barnard was also presented with the flying safety record of the aircraft he had so thoroughly maligned during his time in opposition. To his very great surprise, the F-111 still held the best safety record of all the US jet fighters and the lowest crash rate—undisputed facts given the massive 250 000 flying hour sample size.<sup>137</sup>

After Squadron Leader Ron Green had returned to Australia, he was replaced by Squadron Leader Gil Moore, another RAAF test pilot who would arrive in February 1972. After aircraft conversion, Moore set about recording the performance differences between the F-111A data on which the flight manual was based, and the F-111C. He was also instrumental in re-assessing the canopies of the aircraft out of

storage as they were pitted and crazed after being in a hangar for over four years. Group Captain Milt Cottey then pushed the Americans to have the canopies replaced at US expense, since Fraser-Laird had agreed the aircraft would be delivered 'as new'. The cost saving was more than significant.<sup>138</sup>

Now that the F-111s would be delivered in January 1973, the RAAF sent a new team of air and ground crew over to the US to retrain on the aircraft and prepare to fly them to Australia from late June. With the passage of nearly five years, only 12 of the original 48 aircrew from the original 1968 training cadre were sent back to the US for the pick-up. A total of 15 crews went over, including two sent in early 1972 to train as instructors who also assisted with the ferry home.

On Thursday, 15 March 1973, Squadron Leader Gil Moore and USAF Lieutenant Colonel R.J. Hanson officially signed for F-111C A8-125 in a hangar at Convair Aerospace (GD) at Fort Worth. They were the first non-General Dynamics crew to take possession of this particular F-111C and on this date the F-111C fleet transferred fully to Australian ownership. Watched by a small party including the Australian Air Attaché, Air Commodore Neville McNamara, who represented the Australian Government, and Brigadier General William M. Schoning, who represented the USAF, this time the ceremony was low-key, and this time the RAAF kept the aircraft without further crises.

The first five aircraft were ferried to Sacramento Air Materiel Area (SMAMA) at McClellan AFB, where preparations would begin prior to the trans-Pacific crossing. However, during the cross-America transit, several aircraft lost sections of their flaps due to poor rigging of the flap vane settings. These were soon fixed after the USAF sent out a specialist technician and the aircraft went into a full transit maintenance and system check. The sixth, A8-125, was flown by Squadron Leader Moore to Edwards AFB to conduct a further series of range trials between 9 and



RAAF News

**Above**  
A local newspaper photo of Squadron Leader Gil Moore and USAF Lieutenant Colonel R.J. Hanson officially signed for F-111C A8-125 in a hangar at Convair Aerospace (General Dynamics) at Fort Worth, 15 March 1973.

30 April, and following these it joined the rest at McClellan.<sup>139</sup>

While at SMAMA, the Australians came under what became known to the Americans as *Pacer Kangaroo*—the post-acceptance flight testing and staging program in preparation for the trans-Pacific flights.<sup>140</sup> To the Aussies, it was Operation *Kangaroo Hop*.<sup>141</sup> The whole program had been negotiated as a cooperative logistics supply support

arrangement known as *Peace Land*.<sup>142</sup> On 16 March 1973, SMAMA received the first F-111C, with the remaining aircraft arriving at 10-day intervals. SMAMA staff found they were working with a 45-man RAAF technical team performing inspections and preparing the aircraft for the flight. Each aircraft flew six to eight functional check and shakedown flights with their RAAF crew to detect any problems before the aircraft departed for Australia on 28 May.<sup>143</sup>

Despite all the checks and tests beforehand, one surprising find arose after acceptance. An airman inspecting the WCTB on an aircraft found a ‘Star of Texas’ the size of a dinner plate scratched into the upper surface. Was it deliberate sabotage or a worker



Cottee

**Above**  
USAF official F-111C ferry survey team - December 1972. L-R: Koski, Sansum, Cottee, Newham, Stewart, Connell, Robson, Hughes, Langlands, Roser and Hodges.

ignorant of the foibles of D6ac steel having some fun? Despite an FBI investigation, the culprit was never found, but the damage had to be repaired before another flight.<sup>144</sup>

There were also other niggling problems before the flight to Australia. An undercarriage pin (technically, the landing gear adapter) broke on a USAF F-111 while on takeoff from Takhli in Thailand for a mission over North Vietnam. The aircraft departed the end of the runway, the crew ejected and the aircraft exploded as its load of 24 Mk 82 bombs ‘cooked off’. After technical inspection found cracking, it meant that the pins all had to be replaced.<sup>145</sup> Group Captain Jake Newham, Officer Commanding No 82 Wing and commander of the first detachment, recalled:

[The pins] were made of the same D6ac steel and were chromed and ground down. Now that caused us a problem – getting replacements ... The Americans gave us complete sets, and all had to be replaced.

They had to be NDI’d. They [the Americans] weren’t terribly interested – they didn’t want to know about it. I found that a curious attitude given the hysteria that was attached to the aeroplane.<sup>146</sup>

The quick supply of new pins for the Australian F-111s came as a surprise, given that the entire F-111 fleet needed replacement. It transpired early delivery of replacements was due to the way the RAAF did its maintenance—by following the manufacturer’s instructions to the letter. As far as who got the priority, Colonel William Stringer, a USAF engineering officer, later recalled:

There was a big argument with Ogden [Air Logistics Center] on the question of who got the landing gear adapters – the Australians or TAC. The answer was the Australians. One of the reasons was because the Australians were following our Technical Orders. When the cracks reached a certain limit, they ordered another one and grounded the airplane which is what our Technical Orders said. The [US] Air Force wasn’t doing that, primarily because we didn’t check the [pins] for cracks. You don’t find the cracks, and therefore, you don’t have so many to change.<sup>147</sup>





RAAF Museum

**Above**

The crews arrive.  
Rear L-R: Talbot, Gibbs, Sivyer, Fairbrother, Blyth, Hancock  
Front L-R: Gazley, Miller, Growder, Lake and Lockett.

**Opposite**

Deputy Prime Minister and Minister for Defence, Lance Barnard inspecting the new arrival.

After all the preparation had finally been completed, the first six aircraft took off for Hawaii and the Australian F-111 era had begun. Their route took them from Hawaii to Pago Pago and thence to Amberley for what would be a VIP welcome.

**The Arrival in Australia**

The F-111Cs landed at Amberley on 1 June 1973 to great fanfare with an estimated 3000 onlookers present to witness the arrival. Led by the Officer Commanding No 82 Wing, Group Captain Jake Newham, and navigator, Wing Commander Trevor Owen, A8-125 touched down after being told to hold to await the arrival of the Deputy Prime Minister and Minister for Defence, Lance Barnard. With the official party were the Chief of the Air Staff, Air Marshal Charles Read, the Air Officer Commanding Operational Command, Air Vice-Marshal Brian Eaton, and the Amberley Base Commander, Air Commodore ‘Spud’ Spurgeon. The imagination of the nation was captured with a huge army of press, radio and television newsmen attracted to the event.<sup>148</sup> After 10 years, the F-111 had finally arrived and,



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according to Newham, ‘our air force cred went up in the area and in the world with that aeroplane.’<sup>149</sup> Not many nations had a capability like the F-111 and few would acquire such during the F-111’s service life.

Despite the RAAF euphoria, the media still ran derogatory headlines in nearly all editions, as if hoping some disaster would befall the previously troubled machines.<sup>150</sup> After labelling the aircraft ‘the flying Opera House’ and claiming it had ‘more tests than Don Bradman’, perhaps to their chagrin, the aircraft were soon operating normally and without any of the problems that had kept them grounded for months at a time.<sup>151</sup> No 6 Squadron flew its first two training sorties on 13 June and a week later conducted a simulated maritime strike mission, thus demonstrating the aircraft’s viability in the maritime strike role.<sup>152</sup>

By September, Barnard was now heaping praise on it. However, behind the scenes as Minister, he was

looking to save costs in his Defence portfolio.<sup>153</sup> Unannounced cuts would follow. The period of force structure erosion became known as ‘Barnardisation’, a pejorative term used by Servicemen ‘coined not so much because of the initial cutbacks announced in the 1973 Defence Report, but because of the cuts not announced which were progressively uncovered by the Press.’<sup>154</sup> Under ‘Barnardisation’, the F-111 force was not immune either—two crews were cut from the Order of Battle with the concomitant reduction in flying rate of effort, an inauspicious way to introduce a new capability.

Despite Labor’s hard line with Defence and the F-111 in particular, within five years the then Opposition Spokesman for Defence, Gordon Scholes (Labor), went so far as to state: ‘I acknowledge that the F-111 is most likely, the most capable weapons system in the world for arriving at a target or in the vicinity of a target. I say that so there can be no query about what I am saying.’<sup>155</sup> Whatever it was he was trying to say, the F-111 had exceeded all expectations. Table 4–1 illustrates the point with the original specification requirements against (unclassified) measured performance.<sup>156</sup>

However, while the F-111 had entered RAAF service, it came with three major deficiencies: There was still no reconnaissance capability; it could only carry unguided ‘dumb’ weapons; and the RAAF had no air-to-air refuelling aircraft to extend its bomber’s range. All prevented the aircraft from operating at its full capacity, problems the Air Staff appreciated and set about rectifying. Their plan, however, would take a further 10 years, and was the RAAF’s next major challenge.

Table 4–1: F-111 Specification versus Performance

Parameter	Original ASR36 Specification	F-111 Actual Performance
Speed	Mach 2.0 at 50 000 ft Mach 0.9 (min) at 200 ft	Mach 2.5 above 50 000 ft Mach 1.2 at 200 ft
Radius of Action (ROA)	900 nm (min) including 300 nm at low level Optimum ROA is 1100 nm including 350 nm at low level	Over 1300 nm with max internal fuel
In-Flight Refuelling	Capable, one refuel to achieve ROA	Capable
Weapons Load	Min: 2 x ASMs or 4 x 1000-lb bombs to achieve ROA Desirable: 2 x ASMs, 6 x 1000-lb bombs, or special (nuclear) stores	Up to 48 x 500-lb Mk 82 bombs Usual load of 12 x 500-lb unguided bombs or four Harpoon, or four HARM or four GBU-10 2000-lb guided bombs A wide range of other stores No nuclear weapons
Reconnaissance (after 1980)	All weather – photographic, radar and electronic sensors	All weather – photographic, TV and infra-red sensors
Take-off and Landing	6500 ft take-off roll at max AUW and ISA + 25°C 6500 ft landing roll after clearing a 50 ft obstacle at max landing weight	Take-off and landing roll under 3000 ft depending on weight and conditions. Well within specification

(Source: ASR 36 (see Chapter 2, Table 2–1) and F-111 Flight Manual figures)

Below

The official welcome ceremony with Defence Minister Lance Barnard at the microphone – 1 June 1973.



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Table 4–2: RAAF F-111C Data

Aircraft	RAAF Serial Number	GD Block No & USAF Serial No	First Flight	Delivery/ Acceptance	Arrival in Aust.
F-111C	A8-125	D1-01 / 67-0125	28 August 1968	16 Mar 1973	1 June 1973
F-111C – RF-111C	A8-126	D1-02 / 67-0126	13 July 1968	6 September 1968 & 6 April 1973	1 June 1973
F-111C	A8-127	D1-03 / 67-0127	17 July 1968	6 April 1973	1 June 1973
F-111C	A8-128	D1-04 / 67-0128	30 July 1968	30 April 1973	1 June 1973
F-111C	A8-129	D1-05 / 67-0129	5 August 1968	18 April 1973	1 June 1973
F-111C	A8-130	D1-06 / 67-0130	15 September 1968	27 April 1973	1 June 1973
F-111C	A8-131	D1-07 / 67-0131	22 October 1968	-	26 July 1973
F-111C	A8-132	D1-08 / 67-0132	21 October 1968	8 May 1973	27 July 1973
F-111C	A8-133	D1-09 / 67-0133	22 October 1968	27 July 1973	27 July 1973
F-111C – RF-111C	A8-134	D1-10 / 67-0134	18 November 1968	8 June 1973	27 July 1973
F-111C	A8-135	D1-11 / 67-0135	2 December 1968	29 June 1973	27 July 1973
F-111C	A8-136	D1-12 / 67-0136	5 December 1968	27 July 1973	27 July 1973
F-111C	A8-137	D1-13 / 67-0137	12 December 1968	-	28 September 1973
F-111C	A8-138	D1-14 / 67-0138	17 December 1968	26 July 1973	28 September 1973
F-111C	A8-139	D1-15 / 67-0139	18 December 1968	-	28 September 1973
F-111C	A8-140	D1-16 / 67-0140	-	3 August 1973	28 September 1973
F-111C	A8-141	D1-17 / 67-0141	18 December 1968	-	28 September 1973
F-111C	A8-142	D1-18 / 67-0142	18 December 1968	22 August 1973	28 September 1973
F-111C – RF-111C	A8-143	D1-19 / 67-0143	7 January 1969	6 September 1973	4 December 1973
F-111C	A8-144	D1-20 / 67-0144	2 January 1969	18 September 1973	4 December 1973
F-111C	A8-145	D1-21 / 67-0145	31 December 1968	27 September 1973	4 December 1973
F-111C – RF-111C	A8-146	D1-22 / 67-0146	2 January 1969	-	4 December 1973
F-111C	A8-147	D1-23 / 67-0147	9 January 1969	26 October 1973	4 December 1973
F-111C	A8-148	D1-24 / 67-0148	17 January 1969	-	4 December 1973

(Sources: NAA: A10297, Block 469 – Aircraft Status Cards – F111, A8-126 to A8-141 (with gaps); AAP 7214.016 – F-111 Type Record; www.f-111.net)



Notes

1    *The Sydney Morning Herald*, 11March 1970.

2    OAFH, Air Board Agendum 99/68, 15 November 1968, pp. 5–6.

3    Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force 1961–1984*, Air University Press, Maxwell AFB, AL, 1989, p. 480.

4    ARL file A8/5/52 – Wing Carry Through Box Investigation – F-111C project, June 1969; DSTO file B.11 – Materials Misc, courtesy Dr Richard Chester; and Air Board Agendum 138/71, 22 December 1971. The panel was under the chair of Dr John Farrands, Chief Superintendent of ARL and comprised six members with expertise in structures, metallurgy, fatigue and fractography.

5    Cottee, interview, 15 September 2008.

6    ‘F-111’s uncosted mothballs’, in *Financial Review*, 11 August 1970, p. 2.

7    Howson, *The Howson Diaries: The Life of Politics*, p. 462. Diary entry for 20 September 1968.

8    Beazley, interview, 25 June 2009. Whitlam had served in the RAAF as a navigator during World War II.

9    Group Captain Ron Green, interview, 12 December 2008 and personal papers. The officially recorded handover date was 6 September 1968. NAA: A10297, Block 469 – Aircraft Status Cards.

10   ‘F-111 fatigue problems, and Political Reactions, are a Cause for Concern’, in *Aircraft*, vol. 48, no. 1, October 1968, p. 15; and ‘Crash no 8 as Labour demands release of purchase details’, in *The Age*, 11 September 1968.

11   Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S. 38, 17 September 1968, p. 703; NAA: A5882, C010 Part 1, 17 September 68; and *The Age*, 13 September 1968.

12   ‘Either way, it’s up in the air’, in *The Bulletin*, vol. 90, no. 4621, 28 September 1968, p. 16.

13   NAA: A5872, 542 – Cabinet Minute – F-111 Aircraft – Senate Resolution, Cabinet decisions 542 and 546; Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 60, 12 September 1968, p. 957, repeated in the Senate; Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S.38, 12 September 1968, p. 587; ‘Gorton asks U.S. to clear F-111 contract secrets’, in *The Australian*, 17 September 1968; and ‘Govt. Asks U.S. if it can table F111 documents’, in *The Courier Mail*, 17 September 1968.

14   Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 60, 10–12 September 1968, pp. 803 and 1526 were Barnard’s original requests. Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 60, pp. 883 and 957 were

Whitlam’s requests. Gorton provided some documents on 26 September 1968.

15   Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 60, 10 October 1968, p. 1815. Also Barry Wain, ‘The plane drain’, in *The Australian*, 11 October 1968, p. 9.

16   L.H. Barnard, *Australian Defence – Policy and Programs*, Victorian Fabian Society Pamphlet 18, Victorian Fabian Society, Melbourne, January 1969, p. 15.

17   Group Captain Ron Green, interview, 12 December 2008.

18   For the technically minded, the D6ac steel had the required high stiffness (elastic modulus) and a very high yield strength (up to 210 000 psi or 1450 Mpa), corresponding to a level of stress up to which there was no significant permanent distortion under load. Put simply, it did not stay bent after loading, but when the limit was exceeded, it cracked and failed with little warning.

19   L.M. Bland, *A History of the First Fifty Years (1948–1990) of Support to the RAAF by Materials Scientists and Technologists in Aeronautical Research Laboratories at Fisherman’s Bend, Melbourne, Australia*, DSTO-GD-0300, DSTO Aeronautical and Maritime Research Laboratory, Fisherman’s Bend, 2001, p. 54. The F-111 sections of this report were serialised in *Materials Australia*, September/October 2006 through to August 2008.

20   Dr A.O. Payne, ‘Determination of the Fatigue Resistance of Aircraft Wings by Full-Scale Testing’, in *Top Ten Papers 1907–2007*, DSTO, Canberra, 2008, pp. 31–87.

21   J.Y. Mann, ‘Aircraft fatigue – With particular emphasis on Australian Operations and Research’, DSTO Report R-002-947, Aeronautical Research Laboratories, Melbourne, April 1983, p. 13; Payne, ‘Determination of the fatigue resistance of aircraft wings by full-scale testing’, in F.J. Plantema and J. Schijve (eds), *Full-scale Fatigue Testing of Aircraft Structures*, Pergamon Press, London, 1961, pp. 76–132; and Alan Patching, interview.

22   ‘F-111C Advances Research at ARL’, in *Aircraft*, May 1971, pp. 14–15.

23   Bland, *A History of the First Fifty Years (1948–1990) of Support to the RAAF by Materials Scientists and Technologists in Aeronautical Research Laboratories at Fisherman’s Bend*, p. 59.

24   Cottee, interview, 9 July 2008.

25   OAFH, Air Board Agendum 103/68.

26   DSTO file B.11 – Materials Misc. Originally classified Secret, now declassified. Courtesy Dr Richard Chester, DSTO.

27   Frank W. Davis, ‘Why we are taking the F-111C now’, in *Aircraft*, January 1970, p. 48.

28   Air Board Agendum 53/69, 2 and 5 May 1969; and 65/69, 23 May 1969.

29   Bland, *A History of the First Fifty Years (1948–1990) of Support to the RAAF by Materials Scientists and Technologists in Aeronautical Research Laboratories at Fishermans Bend*, p. 69; L. Molent, *The History of Structural Fatigue Testing at Fishermans Bend Australia*, DSTO-TR-1773, Defence Science and Technology Organisation, Fishermans Bend, 2005, p. 20; *ARL Annual Report 1970–71*, Australian Government Publishing Service, 1971, p. 33; Geoff Swanton, *40 Years of F-111 Aircraft Structural Integrity Support by the Defence Science and Technology Organisation*, Defence Science and Technology Organisation, Melbourne, 2008, p. 5.

30   ‘USAF Scientific Advisory Board third incremental report of ad hoc committee on the F-111’, USAF Scientific Advisory Board, 1 October 1969. Dr Payne was the Australian representative.

31   Air Board Agendum 32/73, 11 May 1973; and Thornborough and Davies, *F-111: Success in Action*, p. 73.

32   Bland, *A History of the First Fifty Years (1948–1990) of Support to the RAAF by Materials Scientists and Technologists in Aeronautical Research Laboratories at Fisherman’s Bend*, p. 64.

33   *ibid.*, p. 75.

34   The RAAF purchase contract was with the USAF, so they were technically the supplier. General Dynamics would only work on the aircraft if the USAF paid (and thus passed on costs to the RAAF).

35   Green, interview, 12 December 2008.

36   Wing Commander Geoff Northam, interview 5 May 2009.

37   Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 63, 28 May 1969, pp. 2324–2341; and vol. 64, 19 August 1969, p. 356.

38   Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 65, 11 September 1969, p. 1235.

39   Jonathan Gaul, ‘F-111: Talk of cancellation’, in *The Canberra Times*, 13 May 1969; ‘The end of the F-111’, in *The Bulletin*, 7 June 1969, p. 13; ‘The unhappy saga of the F111’, in *The Bulletin*, 7 June 1969, p. 23; ‘Australia’s F-111 Concern’, in *Flight International*, vol. 96, no. 3149, 17 July 1969, p. 108; and ‘Will Australia Cancel F-111C Buy?’, in *Armed Forces Management*, vol. 15, no. 10, July 1969, p. 36.

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- 126 ARL had successfully completed nine of the 14 tasks set by the RAAF, the five remaining being for the longer term. Air Board Agendum 138/71, 22 December 1971.
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The most unusual nose which appeared briefly on A8-127 in 1986.

Plan view of the 'classic' F-111C with 'Vietnam' colour scheme as used between 1973 and 1992.



The 'as delivered' colour scheme in 1968. A8-125, the first F-111C had the three-colour camouflage scheme and white 'nuclear flash' underside.



A8-138 was the prototype *Pave Tack* aircraft. Depicted here in No 1 Squadron colours with an AGM-84 Harpoon missile.



The first of four RF-F-111C conversions, A8-126 was also the first F-111C to fly. Depicted here in No 6 Squadron colours, 1981.



F-111A A8-114. The first 'A' model to be accepted in 1982. The 'Sizzling Hot' nose art was only temporary, applied only for the acceptance ceremony.



ARDU used A8-132 for flight trials between 1982 and 1988. The distinctive white colour scheme aided the filming of weapon releases.



A8-514 was the last F-111G in sequence accepted by the RAAF in February 1994. All 'G' models were painted in 'Gunship Grey'. Shown here carrying six Mk-82 low drag bombs.





F-111C A8-148. The last F-111C production aircraft shown here in gunship grey scheme carrying an AGM-142 missile. Date c.2007.



Unique among F-111s, A8-272 'The Boneyard Wrangler' was the only aircraft to fly out of the AMARC graveyard in Tucson, Arizona. Shown here carrying a SUU-20 practice bomb dispenser in 1994. 'The Wrangler' is now in the RAAF Museum.

## A selection of colourful tail artwork that were used to commemorate various anniversaries and show squadron colours



No 1 Squadron adopted the large yellow No 1 flash and diving Kookaburra on its tails in the early 1990s. Initially applied for this aircraft's deployment to the Royal International Air Tattoo (RIAT) at RAF Fairford in the UK in 1990, the pattern remained for several years until the grey scheme was applied. A8-144 shown here was accompanied to the RIAT by A8-142 with similar markings.

The diving Kookaburra is taken from the No 1 Squadron badge. The bird is symbolic of an event that resulted in the award of the VC to Lieutenant Frank McNamara in 1917. McNamara 'swooped' down to rescue another Australian airman, who had crash-landed, before he could be captured by Turkish troops; McNamara's effort was likened to a Kookaburra swooping down on its prey.



After the F-111Cs adopted the 'Gunship Grey' scheme in the early-1990s, the squadrons tail scheme changed again. A8-132 retained the diving Kookaburra, this time clutching a Mk 82 bomb. The yellow cross is the Cross of Jerusalem and is taken from the Squadron's badge. The cross recalls the Squadron's time in Palestine in 1917-18. This artwork shows the aircraft's tail as it was for Exercise *Red Flag* in 2002. The pattern was kept till 2004 and was displayed on a number of aircraft.



Not to be outdone, No 6 Squadron unofficially adopted the rather striking wild boar's head on many of its tails from the late 1990s. The boar's head was generally smaller, with this exception. This tail on A8-274 marks the Squadron's 60th Anniversary after its formation as a RAAF unit in 1939. The boomerang symbol is taken from the unit badge as a boomerang always returns. The boomerang first appeared on the aircraft of the Squadron's predecessor, No 6 Squadron, AFC in 1918.





A8-125 celebrated 25 years of the F-111 in RAAF service. This aircraft was with No 1 Squadron at the time, as shown by the yellow lightning bolt. The pattern was flown between 1998 and 1999.



The RAAF's 75th Anniversary in 1996 heralded a year of celebrations and airshows around the country. F-111G A8-281 sported the official logo adopted by the RAAF for that year.



To celebrate 30 years of F-111 service to the RAAF, LAC Andrew Robinson produced this winning artwork for the tail of A8-131 in 2003.



This No 6 Squadron scheme was worn at the International Air Show at Avalon in Victoria in 2007. No 6 Squadron commemorated its 90th anniversary on A8-125 using the kangaroo symbol that appeared on its AFC predecessor's aircraft in England in 1917. This tail also shows the smaller wild boar's head that appeared on all the Squadron's aircraft early in the new century and remained on the 'G' models until their grounding in 2007.

# 5. IMPLEMENTATION

## 1973–1983

*... Mr Killen has already foreshadowed acquisition of a reconnaissance pallet for the F-111s. This is best seen as a symbol of Australia's defence independence. Up to now we have relied largely on British or American information and the F-111s would help fill the gap.*

John Stackhouse, 1976<sup>1</sup>

The arrival of the F-111s in Australia heralded the beginning of a new era in RAAF operations. For the first time post–World War II, the RAAF had a truly independent strategic strike force in its inventory, but as yet there was no reconnaissance capability and no precision weaponry. The implementation decade ushered in the start of a long period of enhancements to the original ‘as delivered’ bomber capability. As well as coming to terms with its new acquisition, the RAAF had to rise to the challenges of maintaining the force and developing operational doctrine about how it should be used. This chapter examines those issues.

### **Emerging Indigenous Strike Doctrine**

Throughout the 1960s and early 1970s, the RAAF was struggling with a massive re-equipment program and coming to terms with a new strategic environment. The intended use of the F-111 fleet as a deterrent to Indonesia was overtaken by events, and questions arose as to how the aircraft would be employed, where they might be employed and what their concept of operations would be. Given the high cost of acquisition, would they be a ‘silver bullet’ and carefully husbanded, or would they be used in conjunction with other air assets as an advanced strike force?

While awaiting the F-111’s arrival in September 1968, the Chief of the Air Staff, Air Marshal Alister

Murdoch, penned an article for *Aircraft* magazine in which he openly defined the RAAF’s roles.<sup>2</sup> In his order, these were:

- to provide the long-range air strike component;
- to contribute to the air defence of Australia, its Territories and overseas bases;
- to provide prompt, effective and sustained contributions in support of allied operations in South-East Asia;
- to cooperate with allies and the RAN in protecting Australian military and merchant shipping within Australia’s area of responsibility;
- to contribute to the offensive air support of the Australian Army;
- to provide tactical air transport support for the Australian Army;
- to contribute to the strategic air transport support and resupply of the Australian Services; and
- to provide strategic air reconnaissance and contribute to the tactical air reconnaissance.

It is important to recognise the priority placed on strike and reconnaissance, with these roles presaging the RAAF’s first formally espoused doctrine—the 1990 *Air Power Manual*’s three ‘Air Campaigns’ of ‘Control of the Air’, ‘Air Bombardment [Strike]’, and ‘Air Support for Combat Forces’, which included,





RAAF Museum

**Above**

Minister for Air Peter Howson had to constantly defend the aircraft.

*inter alia*, reconnaissance.<sup>3</sup> Unlike the Canberras, which required significant support from other air and ground assets, the F-111s could operate regionally without fighter escort, air-to-air refuelling, jamming, or targeting aircraft and, after progressive upgrades, would eventually carry a wide range of potent land and maritime strike munitions.

The problem of F-111 employment had huge political implications and was the subject of correspondence between the Departments of Air and Defence through the years 1966 and 1967. In preparation for (at the time) a 1968 arrival, and in order to clarify the concept of operations, Minister for Air Howson wrote to Minister for Defence Fairhall to answer a range of employment questions. Howson’s advice in late 1967, crafted by the Air Staff, envisaged a single

squadron deployment with the second squadron held in reserve or in a training role, a change from the original two-squadron forward deployment concept of 1966. The deployment and operational concept derived from the Strategic Basis Papers was to be as follows:

- An F-111C squadron is to be able to operate for protracted periods [30–365 days] at war rates of effort from a base other than Amberley.
- In peace and war the F-111C squadron would not be required to operate smaller detachments away from the deployed base.
- In peace and war the RF-111C force is to be capable of operating a detachment of up to four aircraft for periods of 30 days from a forward base in Australia or its Territories.
- In times of peace, the F-111C squadrons will operate from Amberley except when engaged on periodic deployment exercises to bases in Australia and its territories, normally for 14 days.

Forward basing was to be in South-East Asia or ‘the Darwin/Learmonth area’.<sup>4</sup>

At the time, the focus was more on Communist Chinese aggression, but Indonesia was still regarded with suspicion. This Concept of Operations (CONOPS) was agreed by the Chiefs of Staff Committee (COSC) in November 1967 and set the underlying policy for the RAAF’s strike reconnaissance force for the next 30 years.

By late 1971, Australia’s defence posture was turning more towards a ‘Defence of Australia’ construct, and questions were raised on the utility of the F-111s under such policy. To head off any political agenda, the COSC revalidated the air strike requirement, and this time included counter air, interdiction, anti-shipping, and attacks on vital industries as roles that the F-111 force would be expected to undertake. Furthermore, ‘The F111C aircraft would be in the nature of a deterrent and this is particularly important now that the British Air Force in South-

East Asia has been reduced and also there is some uncertainty regarding the future strength of US strike forces in the Western Pacific.’<sup>5</sup> The COSC needed reassurance and were told that the aircraft could carry 4000 lb of bombs to a radius of action of 1250 miles with drop tanks. Regarding Indonesia: ‘Operating up to maximum radius of action out of Darwin or Learmonth, the F-111C is capable of striking 20 of the 21 counter air targets in Indonesia’<sup>6</sup> No targets were listed, but the paper emphasised that the whole of Java could be attacked if necessary.

Throughout the 1970s, the RAAF continued to use the British publication, AP 1300—*Operations* for its doctrinal underpinning and consequently little rigour was put into defining the Service’s central beliefs. Thirteen years after Murdoch’s public statement on the RAAF’s roles, little had changed. Air Marshal James Rowland reordered the priority giving defence of Australia against air attack (control of the air) as the primary task, followed by air strike, and four air support functions (including reconnaissance and anti-submarine warfare). These were couched in order of equipment priorities at the time, rather than any conscious doctrinal underpinning.<sup>7</sup> The RAAF was focused on an equipment replacement mentality rather than any serious examination of air power capability.

By the time the aircraft arrived, the strategic setting had changed and the RAAF really had no idea how to use it. Sir Neville McNamara, who was RAAF Chief from 1979 to 1982, claimed ‘it would have had to be a serious warlike situation for us to have used them’ and strategic policy ‘was updated with a view to use it elsewhere.’<sup>8</sup> The RAAF had a capability which they did not really know how to use, and the Government had an expensive investment that they found impossible to dispose. However, the first challenge to the RAAF after the F-111s arrived in country was maintenance.

**More Problems Emerge**

All new high-performance aircraft suffer teething troubles as they enter service and the F-111 was no exception. Although it had gone through more than its fair share of technical glitches before delivery, further problems arose once the aircraft were operated in squadron service.

By April 1971, cracks were found in the nose gear of a USAF FB-111, resulting in the USAF developing a new part made from a different alloy. Delays to the modification program meant the replacement parts would not be available till mid-1976. Consequently, the RAAF and USAF conducted the first of many joint research programs to solve the problem. The RAAF also took the prudent step of continuous monitoring and seeking local source manufacture.<sup>9</sup> However, in March 1975, the USAF provided replacement parts out of their limited stock and very quickly the RAAF had 23 of the 24 aircraft back on line.<sup>10</sup> Eventually, local manufacture ensured the crisis was over.

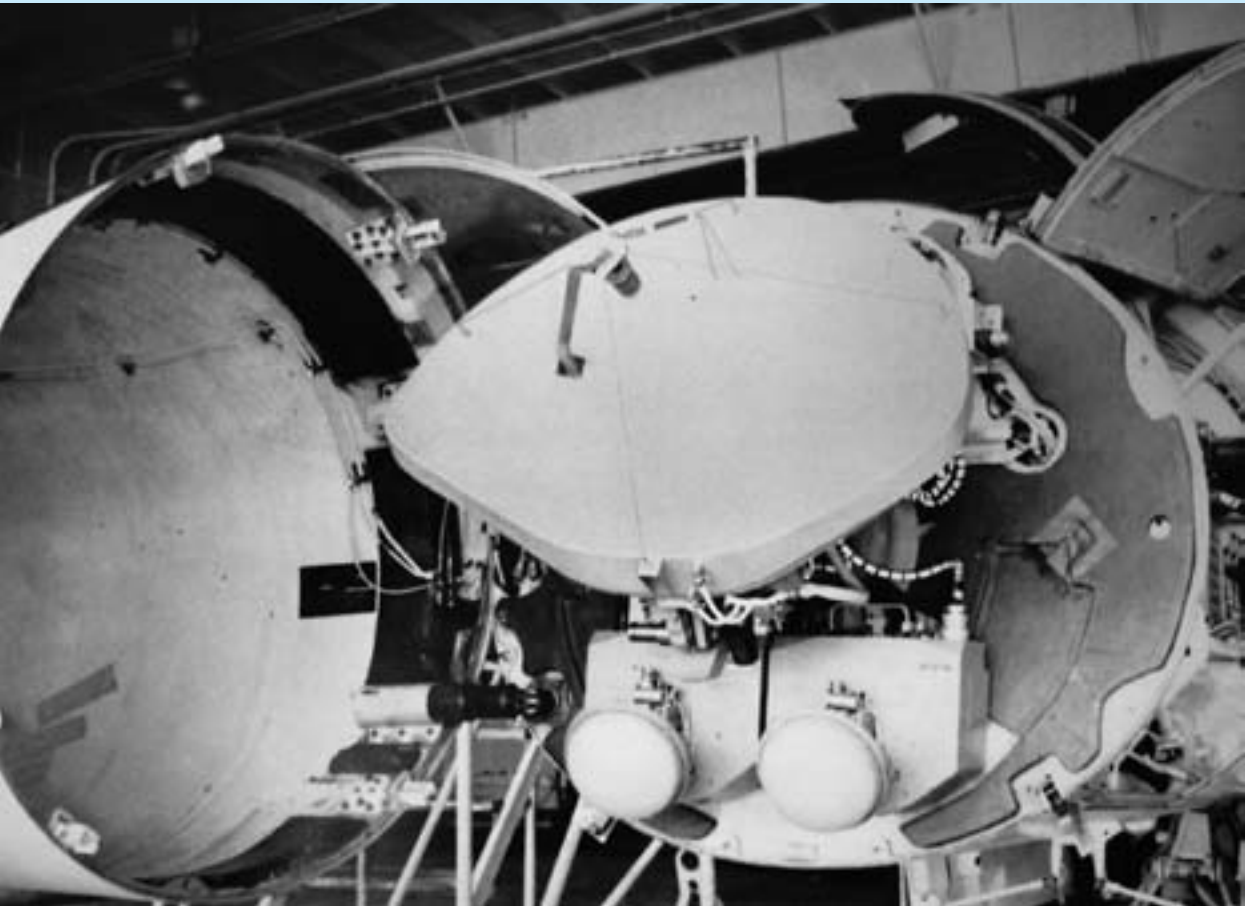
Despite the annoying problems that appeared from time to time, the aircraft performed admirably and were loved by their crews. However, the next issue faced by the RAAF was the question of crew safety and birdstrikes. The long nose of the F-111 required high quality transparencies (windscreens) in the cockpit to prevent distortion and the only product suitable during manufacture was Venetian glass about one tenth of an inch (2.5 mm) thick. While optically pure, it was susceptible to shatter on high-speed impact with even a small size bird. Flight Lieutenant Tony Wilkinson, the first RAAF exchange navigator at Nellis in 1969, recalled: ‘The problem was compounded by the fact that the ejection handles were between the two seats and it was not uncommon for the navigator to initiate ejection in the confusion following a bird strike penetration of the cockpit.’<sup>11</sup>

Travelling at 480 knots (8 nm per minute or 890 kph), penetration of the forward canopy could be fatal if the bird hit a crew member. Such was the

**TF Problems**

The Terrain Following Radar (TFR) system of the F-111 was revolutionary. It allowed the aircraft to penetrate below an enemy's radar at night and in bad weather, notionally at around 400 ft above ground level. The concept was developed in the depths of the Cold War when the expectation was that the US bomber forces would have to penetrate the Soviet air defence system to launch their attacks. By the end of the Vietnam War, the concept had been validated and TF low-level high-speed strike became the mainstay of the RAAF's concept of operations for the F-111.

However, by the late 1970s, the TF radars produced a 'ballooning' problem, the source of which was a mystery. As the aircraft automatically flew over hills, it would fly higher than its set clearance, or 'balloon' upwards. In an operational sense, this was safer than an under fly, but it meant undue exposure during an attack profile. Despite an intense investigation by ARDU into the cause, including shipping the various components back to the US, the fault was assessed to be an incorrect gain setting in the flight control system, but it was never fully resolved. However, once new TFRs under the Avionics Update Program (AUP) were installed, the problem disappeared, so the real reason for the ballooning remained a mystery.



RAAF Museum

Inside the Pig's nose. The nav-main attack radar is the larger dish, the two TFRs are below.

case with A8-133, which crashed at the Evans Head Range on 29 September 1977 after hitting a flock of pelicans. It was the second RAAF aircraft to be lost, but the first fatal. Flown by conversion course pilot, Flight Lieutenant Phil Noordink, and qualified flying instructor pilot, Squadron Leader John Holt, the aircraft was flying at 2000 ft in daylight when struck by at least one bird on the downwind leg. The accident caused an acceleration of the procurement case to fit better windscreen transparencies.

After combined RAAF/USAF trials, a number of combinations of materials were developed to the testing stage. Eventually a new type of windshield made of 10 layers of acrylic and polycarbonate began testing. During sled tests in the US, these windscreens withstood the impact of a 4-lb (1.8 kg) bird travelling at 1.2 times the speed of sound. Wing Commander Bill Collins recalled that the USAF F-111 System Manager at SM-ALC, Colonel Leo Marquez, was concerned about the in-service life this new transparency would give, because the ones that had been used to date tended to craze and develop poor optical characteristics over a short period of time. The crazing was not helped by poor use of cleaning materials in order to clean the windscreen. The new material was called the Advanced Design Bird Impact Resistant Transparency (ADBIRT), and Colonel Marquez graciously offered two sets to the RAAF for trials in the hot and humid environment. These were subsequently tested on A8-125 and A8-126, and after successful flight trials, were ordered to be retrofitted to the fleet without further incident.<sup>12</sup>

**The RAAF Maintenance Philosophy**

On the day of the first F-111's arrival in Australia, the Officer Commanding No 82 Wing, Group Captain Jake Newham, was taken aside by the Chief of the Air Staff, Air Marshal Charles Read, who told him he was 'bloody lucky that you didn't come home as the project was very nearly cancelled'. Newham replied, 'Look Sir, we are aware of the hysteria attached to it, we are aware that it is controversial so I have insisted on a very conservative and cautious maintenance

and flying policy'. Read continued, 'Well you bloody better because if one prangs you'd better go and throw yourself on a fire.'<sup>13</sup> Newham soon found he was not permitted to fly more than three aircraft together, they could not pull more than 4 g and they were not allowed to dive-bomb—all because the staff at higher headquarters were applying unnecessary restrictions. Newham could not convince the RAAF hierarchy that the F-111 was not an F-4, but a 'superb dive-bomber' and it flew beautifully. After Air Marshal James Rowland became Chief in March 1975, restrictions were eased, but it was illustrative of the depths of caution the RAAF hierarchy was prepared to take on its handling of the aircraft, not only for the sake of asset preservation, but for reputation management.<sup>14</sup>

The problem was then: how to maintain the very expensive asset? Since the maintenance organisation 'owned' the aircraft, one of the critical issues argued by Air Vice-Marshal Ernie Hey during his tenure as Air Member for Technical Services was that the F-111 would be fully maintained by the RAAF. Although there was pressure to contract various functions such as engines and avionics repairs out to industry, Hey argued to keep at least one complete weapons system in the RAAF under Air Force maintenance procedures. This, he stated, was for three reasons. First was to keep the variety of high-end expertise in uniform to maintain the suite of technical skills across the RAAF. To do this required experience on 'state-of-the-art' systems such as the F-111—Hey used the term 'professional mastery' for this. Second, it provided immediate on-site response and much faster turnaround times for repairs. And third, Australian industry in the 1970s was not prepared to tool and skill up for such a small number of airframes, nor hold the extensive spares required to meet operational demands.<sup>15</sup>

Minister for Defence Allen Fairhall wrote to the Minister for Air, Peter Howson, to expand the Hey policy proposal. In his letter, Fairhall stated:



My Department has also been advised that support provisioning for the F111 is based upon independence from the United States in the maintenance and operation of the aircraft, subject only to the continuous supply of spare parts and general support in the form of modifications.<sup>16</sup>

This was agreed by the Air Board and confirmed by the COSC in November 1967 and became the maintenance policy for the F-111 fleet—policy that would give the RAAF significant in-depth engineering, maintenance and management skills,

**Below**

Inside the ‘Taj’ on a normal day. The visiting CT-4s were squeezed in.

and pay huge dividends when the Mirage was replaced by the much more complex F/A-18 Hornet. It also meant the RAAF had to update and extend its maintenance facilities for both No 482 Squadron and No 3 Aircraft Depot. Consequently, the squadron workshops, the Depot and the depot test areas all underwent major facilities upgrades.<sup>17</sup>

While the F-111s languished in the US awaiting the various rectifications, the USAF was contracted to provide any necessary maintenance between 1969 and 1973 under Operation *Pacer Wallaby*.<sup>18</sup> It was an opportunity for RAAF technicians to learn and hone skills that would be required once the aircraft arrived in Australia. How to maintain the new acquisition would be the first major challenge, as at this time

Australia was in no position to completely go it alone.<sup>19</sup>

The RAAF had an established, proven maintenance policy for planned flying and scheduled servicing that was applied prior to the arrival of the F-111s. The system was commonly called Periodic Servicing. Servicing for the airframe, engines and many items of equipment was based upon time expired whether the aircraft flew or not. Aircraft were allocated to the flying program so as to establish a regular flow of work into the hanger for scheduled servicing and thus providing some certainty in the availability of aircraft for training and operations. With the F-111, that system changed. Servicings had to be done after a set number of flying hours, and aircraft went in for various servicings called ‘A’ to ‘E’ depending on accumulated flying hours. An ‘A’ servicing was accomplished on the flight line and was the shortest in time to complete. An ‘E’ servicing involved a more complex tear down and inspection, usually taking many months. To guarantee aircraft were available, a stagger of the flying hours per airframe was made, thus allowing the engineers to schedule the respective servicings in an orderly fashion within available manpower, availability of replacement parts and hangar space, while having enough aircraft on line for daily flying operations. The second Commanding Officer of 482 Maintenance Squadron during the F-111 era, Group Captain Ian Sutherland, summed it up thus:

The stagger of flying hours for the aircraft was another issue that needed firm action to resolve. Unless a regular input of aircraft to routine hangar maintenance could be established, unserviceable aircraft can bank up, un-flyable since they exceeded the allowable hours for the scheduled servicing, and created a demoralising and potentially dangerous pressure on the work of hangar crews to put aircraft back on line to satisfy operational programs. At that stage, all tarmac support and flight line servicing was a task of the centralised Maintenance Squadron – an issue which caused much grief in the flying Squadrons who believed they could better motivate

the flight line people if those sections were directly a part of the flying squadron.<sup>20</sup>

Furthermore, the RAAF initially followed USAF maintenance practices precisely. The USAF had a centralised maintenance system which managed servicings under what they called the Phased Servicing basis. Every 50 flying hours, the aircraft got a certain amount of maintenance. By the 300-hour servicing for example, the cycle was at phase seven, and a certain schedule of work was completed. The RAAF soon chose to bundle the servicing phases into specific work packages under its centralised maintenance concept, rather than after every 50 flying hours. While, overall, the same work was completed as in the USAF system, it was easier to manage. Under the centralised maintenance concept, No 482 Squadron held all the aircraft and all the maintenance personnel, while the operational squadrons, Nos 1 and 6, submitted a joint flying program which No 482 Squadron attempted to satisfy. By the time Group Captain Bill Collins arrived as Commanding Officer No 482 Squadron, ‘most of the time we failed. Sometimes we failed slightly and sometimes we failed abysmally.’<sup>21</sup> Former Chief of Air Force and F-111 pilot, Air Marshal Errol McCormack, went further: ‘Centralised maintenance was a disaster for us. It was all right for the Americans who had over 100 aircraft on the flight line. To them, it was a factory and aircraft were just cycled through. We were too small to make that system work. Unfortunately, it took us 10 years to realise it.’<sup>22</sup>

The RAAF had formed No 482 Squadron in 1946 to manage aircraft maintenance at Amberley. In January 1973, Group Captain Ted Whitehead was posted in as Officer Commanding in charge of over 700 personnel. His job would be focused on establishing the F-111 maintenance system. Whitehead had previously been the RAAF Resident Engineer at GD/FW during the troublesome years 1969–1972, so he was well qualified. Whitehead’s first job was to phase out the F-4s, and at the same time establish and operate a suitable maintenance



RAAF Museum



system for the F-111. He recalled that because of the aircraft's complexity, it was decided to centralise the maintenance system for flight line, hangar and workshops in No 482 Squadron; and to retain the full spectrum of maintenance and logistics activities 'in-house. Bigger jobs went to the Depot'.<sup>23</sup> The philosophy was sound and worked, mainly because of the on-site support from General Dynamics Field

**Below**

Flight Lieutenant Mal Hurman waits in his Mirage as A8-125 taxis out for a sortie from Butterworth for an IADS exercise. These exercises became commonplace for the F-111s who acted as a 'rent-a-threat'.

**Opposite**

Maintenance airmen work on a major service at No 3 Aircraft Depot.

Service Representatives at Amberley with their direct links back to the company, as none in the RAAF had any deep understanding of the F-111 systems. The RAAF was on a steep learning curve. The first F-111 to go into deeper maintenance was A8-127, which went into the hangar in August 1974. The servicing took 27 months to complete, double what it would take in 2009. Part of the problem was that the RAAF technicians, who had to incorporate all the USAF mandated modifications as well as service the aircraft, had never performed such tasks before.<sup>24</sup>

The concept of operations for the F-111 force emphasised short-term deployments away from Amberley which had to be self sufficient. These deployments, such as FPDA exercises at Butterworth,



RAAF Museum



RAAF Museum



were usually run at high rates of effort, with aircraft that did not require scheduled hangar servicings. Whitehead recalled that:

Maintenance round the clock was undertaken for unscheduled arisings, there was a well provisioned flyaway kit, and high priority re-supply. Rarely was a sortie dropped under these conditions in the first two years. However, this level of maintenance and supply support was difficult to establish at Amberley under ‘peacetime’ conditions.<sup>25</sup>

Despite the centralised maintenance policy, the question of independent (operational) squadron maintenance arose almost immediately. The aircrew wanted to have their own ground crew and own aircraft. Consequently, after the first 18 months of operations, Whitehead produced a report on maintenance activities. He found the total existing maintenance support in No 482 Squadron was ‘optimum under the variety of current [December 1975] restrictions and operations’ and that it satisfactorily provided ‘an acceptable air worthiness standard, independent squadron operations for short periods while under deployment exercise conditions, and an Amberley based operation that is not totally unacceptable.’<sup>26</sup> He recommended no change to the maintenance philosophy and this was agreed.

In February 1976, the Air Board was replaced by a new body called the Chief of the Air Staff Advisory Committee (CASAC) after a Departmental reorganisation, the main change being that it was now only advisory to the Chief.<sup>27</sup> Among its earliest considerations was the F-111 ‘E’ servicing program. While the Air Board had decided an ‘E’ servicing should be done every three years, the CASAC agreed they should be done every 800 hours or about every 4.5 years.<sup>28</sup> By 1980, the ‘E’ servicing schedule had again been extended to 1500 hours and the ‘D’ to 375 hours, primarily to better align airworthiness checks with effective use of resources, and ultimately to improve on-line availability of aircraft. The level of experience on the F-111 had been built up over the previous six years and after a report into aircraft

serviceability was presented to the CASAC, the Committee agreed to the time extension.<sup>29</sup> However, it soon became clear that on-line availability was not increasing, so a more formal review of F-111 serviceability was instituted under Group Captain Geoff Talbot, a previous Commanding Officer of No 1 Squadron when the aircraft were delivered in 1973.<sup>30</sup>

Talbot’s findings, under the title of ‘A Working Party Investigation into F-111C Serviceability’, became known generally as the ‘The Talbot Report’. The findings were far reaching. The main recommendations included:

- the acquisition of up to four more aircraft to replace the four lost in accidents (F-111As to be converted to F-111Cs);
- the earliest procurement of additional Ground Support Equipment (GSE);
- the expediting of internal fuel tank maintenance work (called the deseal/reseal program) by additional personnel (desirably by civilian or a US contract);
- the acquisition of additional spares; and
- decentralised maintenance up to ‘C’ servicings by No 1 and No 6 Squadrons.<sup>31</sup>

The report’s findings offered for the first time a comprehensive resume of the F-111 fleet status from a support perspective and caused considerable debate in the CASAC. In his summary of the situation, the then CAS, Air Marshal Neville McNamara, stated: ‘I see a need for a more comprehensive knowledge of the total F-111C programme with all requirements being presented together in an overall plan which takes into account projects, maintenance and operational requirements, all of which have an impact on the availability of aircraft.’<sup>32</sup> His words foretold the concept of a Weapons Systems Master Plan, something that would take another 15 years to evolve.

While implementation of the Talbot Report had some effect, it did not solve the low number



RAAF Museum

**Above**  
CAS, Air Marshal Neville McNamara, foresaw the need for a Weapons System Master Plan.

of aircraft available most days. The centralised maintenance system was often blamed, but few had answers to the problem. One contributing factor was the rate of effort (ROE), or number of flying hours programmed each year. The figure had been steadily rising from Year 1 of the program in FY 1973–74. Then the ROE was 5800 hours. In Year 2 it was 7700 and by Year 3 it was 8400, a full 30 per cent growth.<sup>33</sup> Maintenance effort, spares provisioning, and crew training requirements did not keep pace. Consequently, by Year 6 (FY 1978–79) the ROE was reduced to 6400 hours and a year later to 5600 hours, relieving the pressure on the maintenance and logistics systems and allowing a desperately needed catch-up.<sup>34</sup>

This action, combined with Nos 1 and 6 Squadrons’ desire to have their own maintenance personnel,

led to a decision in February 1981 by McNamara to decentralise the maintenance staff and bolster Nos 1 and 6 Squadrons with their own maintenance airmen. By 1982, the RAAF had completed enough servicing cycles to know the average serviceability rate and cost of operation. These both came into question in Parliament when the Minister for Defence, Jim Killen, first replied to a question on notice, and then gave his annual statement on the Defence portfolio. In his earlier reply, the Minister stated that, at any one time, six of the 24 aircraft were in scheduled servicing but that ‘nine were in the United States undergoing Cold Proof Load Testing leaving only 50 per cent of the fleet available.’<sup>35</sup> A month later he added that, ‘The F111, the backbone of our strike force, is almost twice as costly to operate as the Phantoms’, providing voice to further Opposition complaint.<sup>36</sup> Complexity of servicings also increased manpower costs. Between 1978–79 and 1981–82, manpower costs had risen by an average of 72 per cent, a trend that would continue throughout the 1980s and lead to another review of how Defence, and in particular the RAAF, did its business.<sup>37</sup>

**Airworthiness in the RAAF**  
Airworthiness means safe or fit to fly. A system for monitoring and applying safety standards was developed after World War I in an effort to prevent the many accidents that were attributed to mechanical or aerodynamic failure and aircrew error. In Australia, civil aviation took the lead, but the RAAF relied on the manufacturers of their aircraft to provide them with information to maintain an acceptable standard. This worked only when aircraft remained in inventory for short periods, notionally up to five years, but once more advanced aircraft were developed after World War II, this philosophy had to change.  
  
By the 1960s, ARL was undertaking pioneering work into aircraft fatigue and had developed a series of structural inspections and tests. Their work on aluminium aircraft structures led to the ability to



calculate fatigue life of an aircraft. It was also in the 1960s that the Air Member for Technical Services, Air Vice-Marshal Ernie Hey, asked Squadron Leader John Macnaughtan ‘whether the probability of structural failure selected as acceptable by the RAAF was relevant to defining airworthiness.’ Macnaughtan did not know the answer, but he knew the RAAF was fitting fatigue meters to its aircraft to manage individual aircraft for this purpose. Macnaughtan recalled ‘that it was the first time anyone had raised the definition of airworthiness with me’ and he

**Below**

A8-141 pleasing the crowd at the Amberley Air Show, March 1976. The aircraft was later lost over Auckland Harbour after a wheel well fire.

soon found he was responsible for it. Airworthiness management thus became his primary occupation.<sup>38</sup>

Since World War II, the RAAF had a series of technical orders, and from the 1960s, Air Board Orders (Technical) laid down the processes for technical airworthiness. However, there was no instruction linking technical and operational airworthiness until Macnaughtan went on to develop the airworthiness concept further. It was not until 1987 that the RAAF had its first formal Technical Order on airworthiness, and this was for the F/A-18 and was adapted from the Canadian model. From this small start, other Technical Orders were developed across the RAAF fleet and the idea of formal review by Airworthiness Boards (AWBs) came about. AWBs were established in 1990 and consisted of two officers of star rank (one technical, one aircrew), several members from the weapons



RAAF

**Waving the Flag**

After the initial fatigue problems that arose in 1968 caused such public outcry, the Australians were keen to uphold the aircraft’s worth. Consequently, the RAAF undertook something of a public relations program to sell the aircraft that was so controversial. The first opportunity to wave the flag came four months after arrival with a nine-aircraft fly-past, the total number of aircraft in Australia at the time. After being called the ‘Flying Opera House’ by some in the Australian media because of cost and schedule overruns, the F-111 force ironically overflew the real Opera House during the Royal Salute to officially open the building on 20 October 1973.<sup>39</sup> The next opportunity was more of a publicity stunt than a flag-waving. In April 1974, an F-111 was used to re-enact the epic 44-day round-Australia flight in 1924 by Wing Commander Stan Goble and Flight Lieutenant Ivor McIntyre in a Fairey IIID floatplane. It was a feat which earned them the Royal Aero Club Britannia Trophy and widespread accolades across the nation at that time.<sup>40</sup> The F-111 flight was intended both to commemorate the fiftieth anniversary of the original flight and demonstrate the F-111’s range, speed and versatility.

Flown by the Commanding Officer of No 6 Squadron, Wing Commander Ray Funnell, and Squadron Leader John Miller, the re-enactment began at Amberley on 8 April. Flying the route Amberley-Darwin-Perth-Edinburgh-Point Cook-Amberley took 34 hours, including 3 hours in Darwin and an overnight stop in Pearce. While it was not the first round-Australia flight since Goble and McIntyre, it was by far the fastest. Total flying time was 12 hrs 30 mins, a record still held in late 2010.<sup>41</sup>

But the flight again brought the F-111 to the attention of Parliament. Opposition Members of Parliament now had the opportunity to attack the new Labor Government. The Liberal Member for Curtin, Ransley Garland, asked Minister for Defence Barnard why two F-111s and a Hercules were used to carry over 9700 specially printed envelopes around -Australia in the bomb bay, an expedition he referred to as ‘an incredible display of misplaced priorities’.<sup>42</sup> It was not so much any misuse of the asset, but rather the training value that was under scrutiny. Although Barnard might have been embarrassed for a while, philatelists around the country enjoyed the special first-day cover the aircraft carried, and Funnell’s career was undamaged as he went on to become Chief of the Air Staff.



RAAF Museum

A flypast of F-111s at the opening of the Opera House, 20 October 1973.



As the squadrons adapted to the F-111, it became the mainstay of the opposing strike force for exercises in Australia and overseas. The F-111 was usually part of the 'Orange' or enemy force and between 1973 and 1983, operated in the Australian *Kangaroo* series, the US *RIMPAC* exercises in Hawaii, and the Integrated Air Defence System exercises in Malaysia as part of Australia's commitment to the Five Power Defence Arrangements.<sup>44</sup>

Despite the option available to the RAAF with exercises, there was still a large hole in the RAAF's ability to carry out its assigned roles—there was still no reconnaissance capability and no precision weapons.



RAAF Museum

A8-142 arrives at RAAF Pearce on the round-Australia flight. Wing Commander Ray Funnell (right) and Flight Lieutenant John Miller are greeted by the base OC Air Commodore Sam Dallywater, 9 April 1974. Dallywater was the second Project Manager for the F-111 in the 1960s.

system under review, and the Director of Flying Safety, a Group Captain. Their impact was not immediate, but they were later found critical to airworthiness management.

A major part of airworthiness philosophy involves the use of technical manuals. In the case of Australia's F-111s, these were again a unique item. The longer wings and heavier undercarriage made the F-111C an orphan as far as the USAF was concerned, so a set of Australian flight and maintenance manuals was required. In 1972, the issue of RAAF-specific manuals fell to then Wing Commander Bill Collins, the RAAF Resident Engineer at General Dynamics, to resolve. Collins' approach was to selectively use the F-111A and FB-111 publications as applicable. He found that 'the RAAF's approach to technical publications which are at the heart of the definition of airworthiness down at the flight line or in the hangar or in the workshop was lax and poor at

best in many areas.'<sup>44</sup> Collins proposed that General Dynamics cut and paste and write as necessary the text to describe the Australian version.

The early generic approach to technical airworthiness was developed over the years by the RAAF. This was mainly through the complexity of the F-111, which significantly enhanced the approach to fatigue engineering management of projects such as the Mirage, Macchi, and F/A-18 Hornet and better prepared the RAAF to become a smart customer for the Joint Strike Fighter (JSF).

**The RAAF Liaison Offices at McClellan AFB**

Given the RAAF's growing dependence on USAF F-111 support, the RAAF decided to open Technical and Supply Liaison Offices at the Sacramento Air Logistics Center (SM-ALC) at McClellan AFB in California. SMAMA had been renamed



Bob Bennett

**Above**

RAAF Liaison and Exchange Personnel at SM-ALC – 1977. Rear: Wing Commander John Spencer (TLO), Squadron Leader Mike Parks (ELO), Squadron Leader John Power (Exchange) Front: Wing Commander Dave Francis (Exchange), Squadron Leader Bob Bennett (AVO), Sergeant Steve Smith (Equip)

SM-ALC, and was one of five such centres in the US. SM-ALC managed the USAF F-111 fleet, developed modifications and undertook 'deep level' maintenance on the aircraft. The USAF's F-111 equipment specialists and item managers were also located at SM-ALC, giving it a role akin to the RAAF's Support Command. Normal manning of the RAAF Technical Liaison Office was an engineer of Wing Commander rank, a Squadron Leader engineer, and a Warrant Officer engineer; while the Supply Liaison Office was manned by a Squadron

Leader supply officer and a SNCO assistant. Locally employed staff made up the complement. According to Group Captain Bob Bennett:

All USAF F-111 Engineering Change Proposals (ECPs) were put to a Configuration Control Board at SM-ALC and a primary responsibility was for RAAF Liaison staff to monitor this activity for relevance to the F-111C to ensure RAAF requirements were met. Other activities included support (where needed) for 'in-country' RAAF projects, support contracts with GD/FW and investigating various technical problems on the F-111C as well as other RAAF aircraft types. Supply activities included sourcing and coordinating delivery of urgently required spare parts, organising freight for transiting RAAF aircraft (C130s), and a wide range of other supply-related duties.<sup>45</sup>

The office closed with the USAF withdrawal of the F-111 from their inventory.



**Training and Exchanges**

While the F-111 contract specified crew and maintenance staff training as part of the original package, once delivered, the RAAF was on its own. The RAAF started the first of what would eventually be 62 operational conversion courses at No 6 Squadron on 13 August 1973.<sup>46</sup> Courses were based on the USAF’s syllabus and were gradually adapted for Australian requirements. Pilots and navigators were crewed up on course and each was generally assigned to an instructor of the opposite category. Courses lasted four months and consisted of ground school, where all students did all the subjects; and

flying in both the simulator and aircraft, where missions were tailored to suit specific student learning objectives. Little thought was given to RAAF-specific operational concepts or bomber doctrine. US concepts from Vietnam were adopted in entirety and were used until the late 1980s.

As well as training in Australia, an aircrew and engineer exchange program commenced with navigator Flight Lieutenant Tony Wilkinson’s posting to Nellis in August 1969. Pilots did not commence their exchange program until Flight Lieutenant Rick O’Ferrall was posted to Mountain Home AFB, Idaho, to fly the brand new F-111F aircraft (known as ‘the rocket ship’) in January 1974. Each RAAF exchange officer was expected to learn how the Americans operated the F-111, and bring that knowledge back. In the 1970s, many of the USAF instructor crews had combat experience on F-111s in Vietnam, so that added value to the exchange, albeit that the Vietnam concept of operations was obsolescent. According to O’Ferrall:

The original exchange posting was clearly intended to bring the USAF’s considerable F-111 experience to the RAAF. Most of the senior people and instructor pilots I worked with in the USAF [had] a wealth of operational experience that was invaluable to our doctrinal application on the strategic and tactical objective of the F-111 program.<sup>47</sup>

The overseas exchanges would prove vitally important and were one of the few methods RAAF aircrew had to learn about modern fighting tactics, strike doctrine, and F-111 operating procedures. Air Marshal Jake Newham has commented on just how important these exchanges were: ‘The UK, Canadian and US exchanges are terribly important for an air force like us, [because of] our size and our isolation. But, that’s something that’s appreciated by everyone now. If you get further away from war you can create a greater danger of deluding yourself’.<sup>48</sup> The exchanges continued until the USAF withdrew the F-111, and are maintained with further exchange positions on other USAF aircraft types.

The RAAF also decided that the F-111 force should participate in numerous exercises in Australia and overseas. These began with Exercise *Kangaroo I* in June 1974 and continued until aircraft retirement in 2010.<sup>49</sup> Further afield were the Integrated Air Defence System exercises held in Singapore and Malaysia, two-nation air defence exercises held in New Zealand, and the *RIMPAC* exercises, and SAC Bomb Comp, *Red Flag* and *Green Flag* exercises held in the US. Other deployments were made around the world, stretching as far as the United Kingdom. The advantages of such exercises were manifold. Foremost was the valuable training against modern, high-end capabilities including fighters, surface-to-air missiles, and unique electronic warfare environments. The differing climates and terrain also made for refinement of tactics and procedures.

Perhaps the most significant exercise undertaken by the F-111 force in regional terms during the 1970s was the deployment of two aircraft to Cocos Islands in 1977. In its 1975 deliberations, the Defence

Committee endorsed the suggestion of Chief of the Air Staff, Air Marshal James Rowland, that ‘because of Australia’s geographic circumstances, any assault would have to come by sea and/or air and therefore Australia’s strategy should be to meet the enemy in a maritime environment before they reached the shore’.<sup>50</sup> The judgement foreshadowed the build-up of the postwar airfields at Learmonth, Cocos (Keeling) Islands, and Momote on Manus Island for potential maritime operations, although only Learmonth had additional facilities constructed as it was on mainland Australia. Learmonth was over 400 km closer to potential Indonesian targets than Darwin.

The proposed use of Cocos in particular was not without its detractors. After Senator Reg Withers visited the Islands in 1977, John Clunies-Ross, the copra magnate who owned the Cocos estate, accused the Government of specifically building an F-111 base on West Island with the intention of using it for forward operations into the Indian Ocean. Clunies-Ross had no doubt been prompted by a visit of two F-111s in late June 1977 which had surprising consequences. According to Flight Lieutenant Martin Chalk, one of the aircraft navigators:

The trip to Cocos Island was a Lone Ranger comprising two aircraft ... The leg [from Cocos and back] was a maritime high altitude surveillance that took us about 400 nm west of Cocos in a triangular course – as best as I can recall the objective was simply to be there. The report that we received from US Pacific Command, via [our] HQ Operational Command, was that our presence in the central Indian Ocean had temporarily upset the balance of military power in the area – a matter that apparently was rather sensitive. We received this report on arrival at RAAF Base Pearce, so we seem to have ruffled some feathers. I don’t know how they found out as we did not initiate radio contact ... However, we were on full air traffic control reporting with Perth and held flight watch with RAAF Darwin – plenty of sources for enquiring and paranoid ears!<sup>51</sup>

**Below**

F-111 No 1 Conversion Course  
Rear L-R: Mick Nott, Pete Salvair, Bill Best, Rod Scotland, Marty Susans, Les Cavanagh and Jim Graham  
Front L-R: David ‘Stumpy’ Palmer, John ‘JJ’ Wilkinson, John Kennedy, John Ross and Mick Lucas.



Salvair





Chalk

**Above**  
F-111 flights into the Cocos Islands caused trouble with the owner and the US.

That two F-111s could ‘upset the military balance of power’ seems somewhat far-fetched, but the expedition illustrated the aircraft’s potential and deterrent value. Regardless of the Clunies-Ross claim and the US position, the Australian Government bought the island chain in 1978.<sup>52</sup> This renewed focus on Australia’s maritime environment would have profound impact on future strategy and force development, including further contributing to the F-111 usefulness debate.<sup>53</sup>

**The Reconnaissance Requirement**

Regardless of the niggling technical and maintenance problems that the F-111 presented, the RAAF soon enjoyed both the prestige the F-111 brought and the operational flexibility, but still lacking was the

reconnaissance capability specified in the original Air Staff Requirement. Consequently, within a year of F-111 delivery, the RAAF initiated a program to complete the ‘dual’ role component of the strike reconnaissance force.

After the F-111A prototype successfully flew in December 1964, full-scale production was authorised and plans commenced to develop further versions. The USAF priority was for the F-111A to fill Tactical Air Command squadrons, while the USN priority was to get an F-111B aircraft that could be flown off its aircraft carriers. Once these projects were underway, the next requirement was to develop the FB-111A for Strategic Air Command. The reconnaissance version or RF-111A was on the drawing board, but work was put on hold until the number of technical difficulties with the F-111 was resolved.<sup>54</sup> The halt to the RF-111A design was considered problematic by the Australian Air Staff, and in mid-1965, they considered the option

**Aircraft Losses**

Despite its unjustified reputation as an unsafe aircraft, the F-111 entered service in Australia under a ‘kid glove’ policy directed by the Chief of the Air Staff, Air Marshal Charles Read. Read had clearly been under intense political pressure given the election of the Whitlam Government in December 1972 and the Labor Party’s dislike of the F-111 program. Any loss of an aircraft within the first few years would have been a disaster politically and for the RAAF’s reputation, so limits were placed on flight profiles and performance, on minimum crew experience and on weapons delivery. By the time the aircraft arrived in Australia, just over 20 USAF and USN F-111s had been lost, and many of these accidents were attributed to aircrew error. The stringent policy took some years to relax and it was not until 1982 that the RAAF began to post aircrew straight off *ab initio* training courses directly onto the F-111 conversion.

By September 2010, eight of the 43 F-111s operated by the RAAF over 37 years had been lost to accidents, five of which were fatal. Attesting to the RAAF’s ability to handle an advanced aircraft, the first accident put down to technical causes did not occur until five years after aircraft arrival. Table 5–1 lists the total losses and their causes.<sup>55</sup>

**Table 5–1: RAAF F-111 Losses**

Loss	Serial	Remarks
1	F-111C A8-136	Crashed – 28 April 1977, Armidale, NSW Cause: Technical – engine bleed duct failure and fire Non-fatal: Baker / Clarkson
2	F-111C A8-133	Crashed – 29 September 1977, Evans Head, NSW Cause: Environmental – birdstrike through canopy Fatal: Holt / Nordink
3	F-111C A8-141	Crashed -- 25 October 1978, Auckland Harbour, NZ Cause: Technical – engine bleed duct failure and fire Non-fatal: Rogers / Growder
4	F-111C A8-137	Crashed – 24 August 1979, Ohakea, NZ Cause: Environmental and crew error – water ingestion on take-off and engine failure Non-fatal: Kelly / Curr
5	F-111C A8-139	Crashed – 28 January 1986, into sea off Moruya, NSW Cause: Crew – loss of situational awareness Fatal: Erskine / Angel
6	F-111C A8-128	Crashed – 2 April 1987, Tenterfield, NSW Cause: Crew – loss of situational awareness Fatal: Fallon / Pike
7	F-111C A8-127	Crashed – 13 September 1993, Guyra, NSW Cause: Crew – loss of situational awareness Fatal: McNess / Cairns-Cowan
8	F-111G A8-291	Crashed – 18 April 1999, Aur Island, Malaysia Cause: Crew – loss of situational awareness Fatal: Short / Hobbs

Each accident was carefully investigated to determine causal factors and to propose remedies. Some of the losses are discussed elsewhere in this book; however, four were attributed to crew distraction or loss of situational awareness—a normal human condition, given that each occurred at night, at low level and at high speed.<sup>56</sup> In each case, changes to crew procedures were instituted.

The loss of A8-137 at RNZAF Base Ohakea in New Zealand deserves further mention as it changed aircrew postings to the F-111 squadrons. The aircraft was taking off on a rain-soaked runway on 24 August 1979 in marginal weather when the afterburners blew out due to water ingestion. Flying Officer Mark Kelly, the pilot, elected to abort the take-off but the aircraft aquaplaned without slowing down. As the aircraft rapidly approached the end of the runway, the navigator, Flight Lieutenant Al Curr, initiated ejection. The crew escaped with minor injuries, but the aircraft caught fire and was completely destroyed. The subsequent Board of Inquiry found that the tyres were not chined and there was not a procedure for double engine failure on take-off in the emergency checklist.<sup>57</sup>

The Board of Inquiry did not stop there. As well as recommending the introduction of chined tyres and updates to the checklist emergency procedures, it found that aircrew posted to the F-111C should undertake the Introductory Fighter Course at No 2 Operational Conversion Unit before a posting to F-111s. While most of the F-111 pilots up till then had come from a Mirage, Phantom or Canberra background, non-fast-jet aircrew were starting to arrive, and they needed honing of their reflexes to cope with the highly dynamic environment presented by the F-111. The Introductory Fighter Courses began in 1981 and were to pay dividends in how the aircraft would be operated. The courses led to the first changes in operational doctrine and a move away from the Vietnam-era tactics previously employed.



DDAAFS

Flying Officer Mark Kelly and Flight Lieutenant Al Curr's crew module after their ejection at Ohakea in NZ. The crash changed the way crew training was conducted.

of acquiring a further six strike aircraft for later conversion to the RF model once General Dynamics had completed the design.<sup>58</sup>

After the F-111B and F-111K were cancelled, work began on the FB-111A and F-111D, and in 1966 the

USAF briefly revisited the RF-111 option. Cuts to the original F-111 program of 1726 aircraft, the end of the F-111A production line, and pressure to get the Mark II (digital) avionics working meant the original plan for an RF-111A translated into acquiring 60

RF-111Ds. The role of the F-111D was subsequently changed for it to be a reconnaissance model only with a reconnaissance pallet designed to fit inside the aircraft weapons bay.<sup>59</sup> Unannounced to Australia, who had a small stake in the reconnaissance program, was McNamara's decision in early 1965 to defer RF-111A/D development till 1970–71 due to budget stringency.

Delays to the USAF RF-111A program also meant delays for Australia. On 23 August 1965, Senator Shane Paltridge, the Australian Minister for Defence, wrote to McNamara complaining of US contractor slippages to the RF-111A design. He pointed out that the 'large gap' between delivery of the strike aircraft and the reconnaissance version of two to three years meant Australia was likely to get two different aircraft build states, which was not good for spares compatibility and maintenance. He therefore proposed to exercise the contract option to accept six strike aircraft in lieu of the six reconnaissance variants. McNamara replied a month later in which he explained the delays in the reconnaissance pallet development were unavoidable, but reassured the Senator that 'it is our intention to develop and have available a reconnaissance capability using the basic F-111A air vehicle'. The development schedule anticipated flight test beginning in early 1967, with full production from January 1970.<sup>60</sup>

McNamara went on to recommend Australia either take the option for six additional F-111As immediately and retrofit the six aircraft at a later date (making 30 aircraft in all for the RAAF) or take six additional F-111As and purchase a further six RF-111As later (making 36 in all). Paltridge was inclined to take option one. He proposed the amendment to Cabinet two weeks later, but Cabinet agreed only 24 aircraft in total, with subsequent retrofit of a reconnaissance pallet to six of these when a pallet became available.<sup>61</sup> Cabinet intended that the RAAF would take delivery of 24 F-111C aircraft as planned between July and November 1968, and in early 1970, six aircraft would be flown back to the US to be modified for reconnaissance at a cost of \$8.8m.<sup>62</sup>

By April 1968, the cost of the reconnaissance retrofit had escalated to US\$27m and Cabinet was faced with yet another round of criticism from the Opposition. At their meeting on 9 April, Cabinet decided to postpone fitment of the reconnaissance package while keeping the US engaged on design work. To keep abreast of developments in the US, and as previously mentioned, Cabinet authorised a high-level visit to discuss the reconnaissance option and other F-111 matters, led by the Secretary of the Defence Department, Sir Henry Bland.

The Bland mission had as one of its objectives to determine the status of the RF-111A and how Australia could participate in the development program. The team held a meeting on 8 August 1969 with US Defense Secretary Melvin Laird, Acting Air Force Secretary John McLucas and Major General Otto Glasser, the USAF F-111 Program Manager. Accompanying Sir Henry was the Secretary of the Department of Air, Fred Green, the Chief of the Air Staff, Air Marshal Alister Murdoch, the Air Member for Technical Services, Air Vice-Marshal Ernie Hey, and the Chief Defence Scientist, Henry Wills.

The Bland team discovered that the USAF had delayed development of the RF-111A as their intention was to fit the aircraft with Mk II avionics which had its own problems. The reconnaissance version would become the RF-111D which meant commonality problems for the RAAF, and a cost increase of up to \$20m above that expected.<sup>63</sup> Bland reported that the options available to Australia for F-111 reconnaissance were fourfold: to retrofit six F-111Cs at an estimated cost of US\$54m (Bland mission figures); to purchase an additional six F-111s at a cost of US\$6.986m per aircraft and retrofit these with modern reconnaissance equipment at an estimated cost of US\$140–150m; to purchase eight reconnaissance Phantoms (RF-4C or RF-4E aircraft) at an estimated cost of US\$80–100m, plus two tanker aircraft (making a total estimated cost of US\$130–140m); or to defer the decision to a later time.<sup>64</sup> As the proposed RF-111C costs were estimated to rise from US\$34m to US\$54m, Bland deemed it too



early to consider an RF-111C, and Cabinet agreed.<sup>65</sup> Not surprisingly, Cabinet deferred the decision, as escalating F-111 costs were in the sights of the Australian media, and purchase of undeveloped and expensive reconnaissance aircraft would just make matters worse.

By 1970, US\$118m had already been spent on development of the RF-111A and RF-111D, but at the time of their cancellation only one F-111A and no D-models had been converted to an RF variant. Although the sole RF-111A underwent successful flight trials from December 1967, within a year, the aircraft was transferred for research and development work. The RF-111 program had cost a total of US\$145m and there was nothing to show.<sup>66</sup> The RAAF was now left with no US-sourced reconnaissance option.

Reconnaissance Revisited

Once the F-111 fatigue problems were rectified and final acceptance of the F-111C fleet agreed in December 1971, a Cabinet Submission re-raised the issue of the lack of reconnaissance capability, with Bland’s four options still on the table.<sup>67</sup> By 1971, it was clear that the USAF was no longer interested in a reconnaissance version of the F-111 and US Deputy Secretary Packard advised Canberra accordingly. The single RF-111A was eventually scrapped, becoming a ‘gate guardian’ at Mountain Home AFB, and the RF-111D version never went into production.<sup>68</sup> However, as the USAF had done preliminary design work on a pallet to fit into the weapons bay cavity on the F-111, they were willing to let the RAAF have the data package for US\$3m, an option too good to refuse.

The USAF pallet was designed to carry a comprehensive array of optical cameras and an infra-red line scanner (for imaging at night), plus a Westinghouse AN/APD-8 sideways-looking airborne radar (or SLAR). The SLAR gave map-like images of the landscape it overflowed. A digital computer system was incorporated to manage the equipment, and flight trials on the RF-111A had shown considerable

promise.<sup>69</sup> The package appeared to meet Australian requirements.

Project Air 14 – The RF-111C Conversion

The Australian Five-Year Defence Program 1973–1978 (called the Pink Book) programmed a spend spread of A\$24.1m for a reconnaissance capability with the year of decision being 1974–75. It was an ambit claim by the Air Staff.<sup>70</sup> Regardless of the F-111 politics, on 31 December 1974, Defence Minister Barnard approved the expenditure of A\$300 000 for a Project Definition Study (PDS). Early in the new year, Squadron Leaders Errol McCormack and Howard Kaye arrived in the US for discussions with General Dynamics on how best to proceed. McCormack had previously flown RF-4Cs with the USAF and was the reconnaissance Operational Requirements staff officer in Air Force Office, and Kaye was an engineer with reconnaissance responsibilities. They were joined in the US by Wing Commander Bill Collins who administered contracts with General Dynamics at the time.

In 1975, the RAAF tasked General Dynamics with the study under a Major Equipment Proposal entitled Project Air 14, Issue 5 of August 1975 – A Strategic/Tactical Reconnaissance Force based on the F-111C.<sup>71</sup> The Project Definition Study that McCormack and Kaye had drawn up recommended development of Engineering Change Proposal (ECP) 5042, and led to the development of a Foreign Military Sales acquisition case, but the number of aircraft to be modified was dropped from six to four. Project Air 14 was renamed Project 5014 to better discriminate between other Service programs.<sup>72</sup>

In a contemporary article considering Defence acquisition, the popular *Aircraft* magazine astutely observed, ‘... Mr Killen has already foreshadowed acquisition of a reconnaissance pallet for the F-111s. This is best seen as a symbol of Australia’s defence independence. Up to now we have relied largely on British or American information and the F-111s would help fill the gap.’<sup>73</sup> Australian defence planners

were looking to close gaps in capability that had otherwise been filled by foreign forces and, as Australian academic Hugh White has observed, ‘[we] were starting to consider defence self-reliance as serious defence policy.’<sup>74</sup>

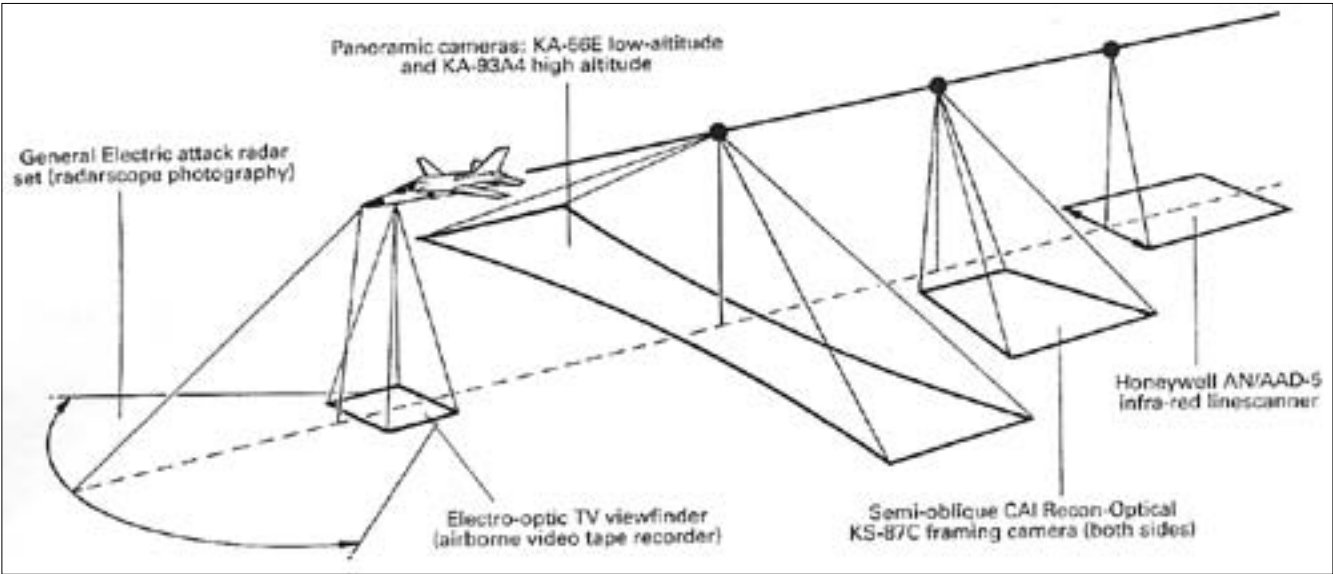
In November 1976, the Government’s White Paper approved the modification of four F-111s and the RAAF sent a team to visit General Dynamics to develop the proposal. Heading the team was Air Commodore John Henze, a senior engineering officer from the RAAF’s Support Command. He was accompanied by Wing Commander Errol McCormack, Squadron Leader Frank Grimshaw and D. Biddle from the Department.<sup>75</sup> The team made their visit to General Dynamics and a number of reconnaissance sensor manufacturers between 20 February and 18 March 1977, and recommended the RAAF incorporate a reconnaissance pallet rather than use wing-mounted pods which were the other option. They also agreed the ECP approach rather than a formal air project. By calling the project an ECP, the tortuous path of Defence Committees

and Departmental over-scrutiny was avoided, and with allocation of funding, the project progressed. Total revised cost of the ECP was expected to be US\$21.45m.<sup>76</sup>

The Australian press reported the intention to acquire a further six second-hand F-111A aircraft (as was previously mooted) for the reconnaissance role, but this was pure speculation on their part as only four aircraft were to be modified, and all would come from the existing fleet.<sup>77</sup> The Government approved the project in May 1977 at a cost of A\$28m and Project 5014 was formally commenced with Group Captain Bob Kee appointed the Project Director and Squadron Leader Frank Grimshaw the Project Manager.<sup>78</sup>

The aim of the project was to introduce a credible long-range reconnaissance capability into the RAAF without detracting from the aircraft’s range or performance.<sup>79</sup> The RAAF had virtually no reconnaissance capability at the time, although the Canberra and Mirage could be fitted with a single camera, and the P-3 Orions had a limited over-land capability. There was brief consideration given to including a mapping facility, but this was rejected early on. The F-111 was considered too expensive and valuable an asset to use for survey and mapping

Below  
A graphic showing the various reconnaissance camera swathes.



82 Wing





82 Wing

**Above**  
The reconnaissance equipment pallet that sat inside the weapons bay.

work. Space was, however, set aside to add a mapping camera in future if need dictated.

Four F-111C aircraft were chosen for conversion, including A8-126 as the prototype to be modified by General Dynamics at Fort Worth. The remaining three, A8-134, A8-143 and A8-146, were converted at No 3 Aircraft Depot at Amberley using kits supplied by the manufacturers. A project team was subsequently assembled with the modification of the prototype managed through to mid-September 1979. Consequently, A8-126 was flown back to Fort Worth on 11 October 1978 to begin the reconnaissance modification. The project was managed out of the

Air Force Technical Services Division, there being no project management organisation back in Australia at the time. Project 5014 was overseen by a small team of RAAF technical experts, with Squadron Leader Kevin Leo, the on-site Project Engineer. Their job was to manage the detailed project planning and coordination between Air, Equipment and Engineering staff officers, and the manufacturers, as well as the USAF. As important were the technical airmen attached to the project as they would eventually return to No 3 Aircraft Depot to conduct the modification of the final three aircraft between July and September 1980, and train other Australian maintenance staff.<sup>80</sup>

The RF-111C pallet contained a suite of optical and infra-red cameras covering both vertical and oblique angles, but the sideways-looking airborne radar option from the RF-111A design was dropped,

and the more expensive and technically challenging electronic emission gathering capability was also excluded. A range of cameras was proposed to take into consideration all flight regimes—high and low altitude, plus vertical, oblique, continuous strip and panoramic coverage. A cockpit TV monitor for centre-line tracking and target alignment, and a voice recorder for post-flight debriefing, were also part of the refit.<sup>81</sup>

The components were purchased by the RAAF and provided to General Dynamics (the integrator) as Government Furnished Equipment or GFE, with the USAF managing the contract under their Foreign Military Sales organisation. While the equipment was somewhat dated by the time the RAAF registered interest, it was more than suitable for the F-111 application. According to Project Director, Group Captain Bob Kee: ‘Surprisingly, the project experienced very few problems. However, two were of concern initially: air turbulence causing image distortion, and optical fabrication being deleterious to image fidelity. Both proved inconsequential.’<sup>82</sup>

The prototype was rolled out on 18 April 1979 and went into a four-month flight test program in Texas commencing in May. With the RAAF engineering staff holding oversight, initial flight trials by Squadron Leader Jack Lynch and Flight Lieutenant Martin Chalk were successfully flown against an array of ground targets and calibrated markers, so that camera resolution, distortion and motion errors could be compensated. Flight procedures were also developed and these went into the Australian Flight Manual. A8-126 returned to Amberley on 22 August 1979 and was shortly deployed to Darwin for further flight trials in a tropical environment, before being released back into squadron service.<sup>83</sup>

The incorporation of the reconnaissance pallet completed the original 1960s requirement for a strike reconnaissance capability to meet Australia’s operational needs, albeit 20 years late. The trials results proved promising, with the RF-111C considered a very stable long-range reconnaissance

The RF-111s all eventually received nicknames as follows:

- A8-126: ‘Cloud Dodger’ – after a remark by a General Dynamics engineer, following days of cancelled test flights due to bad weather. It was the only F-111 that would not fly in cloud.
- A8-134: ‘Doubtful Dodger’ – name picked by the airmen because this aircraft was a real ‘pig’ to get through the modification program due to the adverse interplay of engineering tolerances between the modification package made at General Dynamics and the aircraft’s dimensions.
- A8-143: ‘Draught Dodger’ – name also picked by the airmen for reasons that are a little obscure.
- A8-146: ‘Artful Dodger’ – after the first very successful RAAF modification of an F-111.

platform, with over 1000 nm (1850 km) radius of action now possible including 400 nm at low level. The remaining three aircraft were converted at No 3 Aircraft Depot during 1980 using kit sets supplied from General Dynamics. At the same time, a Photographic Processing and Interpretation Facility (PPIF) was built at Amberley comprising a permanent facility with deployable cabins. The cabins were C-130 Hercules transportable and used to process the reconnaissance film and interpret the data. They were staffed by qualified RAAF photographers, photographic interpreters and intelligence officers. The PPIF allowed the RAAF to develop the roles of intelligence gathering and imagery interpretation.

The RF-111C conversion project was remarkable in that it came in on budget and schedule, and performance was as predicted. It was one of very





Chalk

**Above**  
The first RF-111C fitted with ferry tanks prepares to depart McClellan AFB.

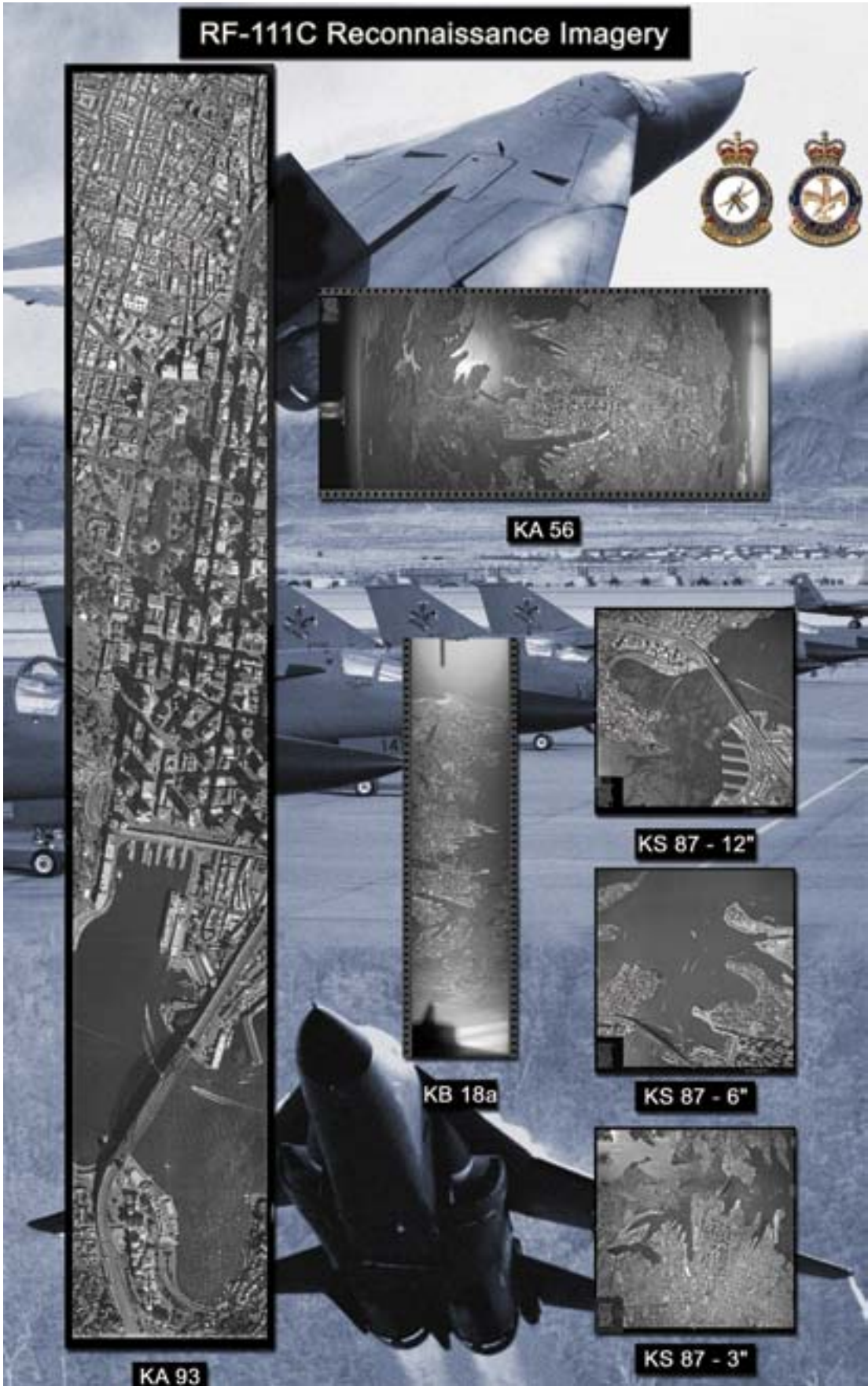
**Opposite**  
A montage of reconnaissance shots taken over Sydney Harbour to demonstrate the camera angles.

few projects that achieved these milestones. The RF-111C boasted the first Infra-red Linescan system in the country, and optical cameras provided the intelligence systems with more data than could be analysed quickly. The RF-111s provided 24-hour coverage of selected targets of interest, and this greatly increased the RAAF’s intelligence collection ability. Participation in the USAF’s premier reconnaissance competition—Reconnaissance Air Meet or RAM—as ‘first-timers’ in 1986 illustrated the aircraft’s capability and, within two years, crews were winning ‘top crew’ and other awards at the competition.

No 6 Squadron took on the reconnaissance role and operated the aircraft as a reconnaissance flight until the flight was disbanded on 1 July 1996. The aircraft were passed to No 1 Squadron, which permitted greater crew flexibility. Meanwhile, the RAAF finally

had the reconnaissance capability it desired and this ushered in a more balanced air force better able to meet government requirements.

**Weapons – ‘A Parlous State’**  
The next issue facing the RAAF in the 1970s was weapons. When the F-111s arrived, they were only cleared to carry external fuel tanks, practice bombs and Mk 80 series unguided bombs,<sup>84</sup> a problem briefed to the Chiefs of Staff Committee in November 1971 when they were considering whether or not to accept the aircraft.<sup>85</sup> Weapons clearance costs amounted to an additional US\$1.1m<sup>86</sup> and given the costs already incurred, the Air Board was loathe to seek additional funds at the time. Adding to the problem of acquiring weapons was the Defence acquisition process which had become bureaucratically cumbersome, and bogged down by various senior Defence committee considerations. Each project was considered on its own merits—there was little in the way of systems thinking at the time. Hence, weapons were one project, electronic warfare equipment another, aircraft another, and so on.



82 Wing



**A Typical Reconnaissance Flight**

A typical low-level tactical reconnaissance mission starts with the arrival of the Air Task Order from No 82 Wing Headquarters several hours before the mission is to be flown. Two imagery analysts are assigned to the pilot and navigator, and the foursome begins to plan the mission. Target profiles are decided and the photographers advised of the sensor configuration and film quantity necessary to conduct the mission.

Photographers then load the film magazine into the aircraft and pre-flight the aircraft sensors. While the magazines are being loaded, the planning team plots the targets on large-scale maps and decides suitable attack approaches and exits. This is done with terrain, imagery requirements and enemy defences taken into consideration. After a pre-mission brief, the aircrew conduct a pre-flight inspection of the aircraft.

A typical low-level mission will be flown at 75 m above the ground level at more than 1000 kph; range can be more than 1500 km. Once in the target area, the aircrew report any activity or installations that could be of significance. These observations can be fed immediately into the intelligence system and act as a backup in case of sensor malfunction.

While the RF-111C is airborne, the imagery analysts familiarise themselves with the target area by using previous target imagery and reading intelligence reports. As soon as the RF-111C's engines are shutdown on return, the film magazines are unloaded by the photographers and taken back to Reconnaissance Flight for immediate processing. While it is being processed, the aircrew are being debriefed by the imagery analysts and the intelligence officer on the mission.

During debrief, the aircrew relate what they saw in the target area and along the entry and exit routes. As soon as the film is processed, the imagery analysts view the negative film on a purpose-built light table using stereoscopes and magnifying devices. They analyse the target area with emphasis on the Air Task Order's intelligence requirements. Once analysis is completed, a Reconnaissance Exploitation Report is produced and dispatched, with annotated prints made from the negatives to follow if required.

by Flight Lieutenant Rick Keir (previously published in *Defence Update* No 8, Defence PR, Canberra, undated)

The 'committee system' was entrenched in 1972 when Sir Arthur Tange's review of the Defence establishment was implemented by Government. The committees were predominantly run by Defence civilians, who generally had little knowledge of modern military equipment, its capability or method of employment on the modern battlefield. These committees included the Force Structure Committee, the Defence Force Development Committee, and the Defence Source Definition Committee, and all added two or more years to the acquisition process. The priority was driven by the Force Development and Analysis (FDA) Division in Defence Central under Deputy Secretary B. The Services would put

up a Major Equipment Submission, FDA would write up the 'Agenda' and, if successful, the project would be listed in the Pink Book, a classified table of unapproved projects. As projects progressed towards Year of Decision (ie, funding approval), they entered the White Book, a book of classified spreadsheets for approved projects. To many staff officers, the process seemed hit-and-miss as to whether a project went through, and many thought the role of FDA staff was as 'spoilors'.<sup>87</sup>

In the mid-1970s, all RAAF offensive platforms had little in the way of modern weaponry. The Mirages were poorly equipped with AIM-9B and R530 air-

to-air missiles, both at least two generations old. The P-3s came fitted for Harpoon anti-ship missiles, but no weapons were in inventory, and their torpedoes were of 1950s vintage. The Air Weapons Study of December 1975 recommended the acquisition of a range of guided and unguided bombs, but the recommendations were not endorsed by the Air Board other than for war reserves and 'those weapons already programmed for acquisition'.<sup>88</sup> Sophisticated as the F-111 was, it too was poorly served, and given the intention of the RAAF to use the F-111 to attack pinpoint targets at night, the use of Mk 82 unguided bombs made this a mockery. Although the F-111 could carry up to 48 Mk 82s, the accuracy would have been little different to the saturation bombing of Germany and Japan during World War II.<sup>89</sup>

However, Precision Guided Munitions (PGM) for the strike force were under serious consideration as early as 1966. The Air Staff were examining options for Martel (a TV-guided air-to-surface missile), and AGM-62 Walleye (a TV-guided glide bomb), the latter reaching ECP status, but neither progressed beyond the early consideration stage.<sup>90</sup> In 1978, a staff paper was drafted by the Air Requirements – Weapons (ARWPN) staff on the situation. The paper was entitled 'A Parlous State' and presented a situation report of the RAAF's lack of weapon capability. It drew an immediate response from Air Board members and Chief of the Air Staff, Air Marshal Neville McNamara. According to Wing Commander Peter Ekins who was responsible for weapons at the time:

A strategy evolved and was pursued to firstly acquire a graded operational capability for RAAF offensive aircraft which would meet the strategic needs of Australia. This ranged from a 'police action' deterrent of air-to-ground gunnery, through a suite of guided stand-off weapons (with increasing stand-off range), to a comprehensive maritime strike capability to protect the 'moat' surrounding continental Australia or to strike targets overseas.<sup>91</sup>

Equally important was the need to transition from an aircraft replacement and separate weapons purchasing mentality to a holistic 'weapons systems' philosophy.

**The Introduction of Laser-Guided Bombs**

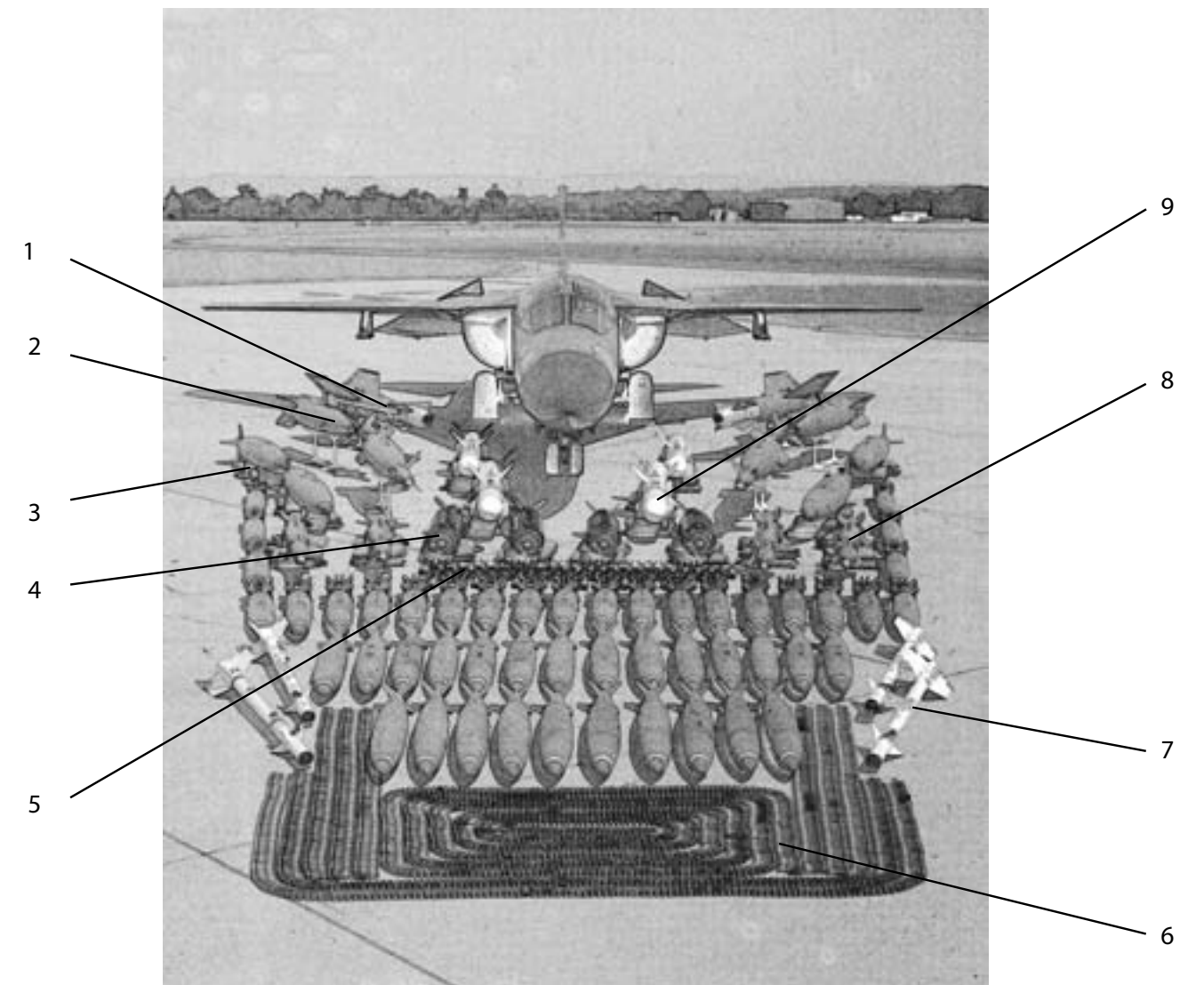
Once the senior management of the Air Force appreciated the 'parlous state' of weapons in the RAAF inventory, matters changed. By the end of the decade, the RAAF Operational Requirements staff had raised 'Project Air 58 – PGMs for the Strike Force' with the year of decision set for 1979–80. Meanwhile, the US company, Texas Instruments, had developed a Laser-Guided Bomb (LGB) kit to fix to the nose and tail of the Mk 82 bomb and were interested in selling this to Australia. Using a sensor in the bomb's nose, the kit could detect reflected laser energy from a target and send correction signals to the bomb's tail section. The corrections would 'fly' the bomb to the target, thus greatly increasing accuracy and minimising collateral damage. The laser energy could be fired from a designator on the ground or from an aircraft. The LGB kits came in a range of sizes to fit the various Mk 80 series weapons and were called Paveway—'Pave' standing for Precision Avionics Vectoring Equipment. The weapons under consideration were of the GBU-12 (Mk 82 500-lb class) and GBU-10 (Mk 84 2000-lb class) and each was compatible with the F-111 bomb racks.<sup>92</sup>

Because there was no laser designator in Australia at the time, DSTO Optoelectronics Group under John Pyle, and Weapons Systems Research Laboratories under Geoff Wheaton, set about building one for ground use. Known as the 'Sewing Machine' the device was built by DSTO at Edinburgh and was used successfully at Woomera. Meanwhile, Texas Instruments LGBs were cleared for use on USAF F-111s, and the company was willing to provide a small number of LGB kits for RAAF evaluation, initially for use on the Mirage. The company's intention was to use the clearance data for generate sales to Mirage operators worldwide. The trials





Defence PR



Defence PR

1. GBU-15 TV/optically guided glide bomb
2. GBU-10 laser-guided bomb
3. Mk 84 2000-lb bombs (unguided)
4. Karinga cluster bomb unit
5. 25lb practice bombs
6. 20 mm cannon rounds
7. AIM-9B air-to-air- missile
8. GBU-12 laser-guided bombs
9. AGM-84 Harpoon anti-ship missile

#### Opposite and above

The 'classic' jet with the array of weapons available after the arrival of LGBs.



**Project Karinga**

As well as acquiring conventional blast fragmentation weapons, among the range of bombs under early consideration was a cluster munition—one that could be released at low level and high speed, and scatter anti-tank or anti-materiel bomblets over a wide area. Australia's foray into modern air-dropped cluster munitions came out of a series of working panel discussions of The Technical Cooperation Program (TTCP) in the late 1960s.<sup>93</sup> This led the staff at the Weapons Research Establishment (WRE) at Salisbury in South Australia to begin working on the design of an indigenous cluster bomblet that could meet the RAAF's requirements.

In 1968, Air Staff Requirement ARM 51 was issued for a Project Definition Study to consider an Australian-designed cluster weapon.<sup>94</sup> During the progress of the study, the scientists and engineers came up with the design for a canister with a retarding parachute that could hold up to 500 one-pound bomblets, and when deployed, would release the contents. Trials on the Mirage were promising and approval to proceed was finally given in late 1971. Development of such a weapon that could go into Australian production would take about 3 to 4 years and it was then that it was named *Karinga*, a local Aboriginal word meaning 'today'.

By the mid-1970s, and after further successful trials, the RAAF developed 'Project Air 13 – Cluster Weapon', to be managed in four phases:

- Phase 1 – a desktop analysis of the various weapons, including the DSTO-developed *Karinga*, the US Rockwell CBU-52 and CBU-58, and the British BLU-755.
- Phase 2 – operational test and evaluation of short-listed contenders.
- Phase 3 – production of training requirements (60 weapons).
- Phase 4 – production of war reserves (3488 cluster bomb units).<sup>95</sup>

The Phase 1 desktop analysis found that the *Karinga* could meet the project's requirements, so the idea of a fly-off with the US and British designs was dropped. As *Karinga* development progressed, the RAAF conducted further flight trials in 1977 and 1978 using a Mirage and dropped 25 weapons at Woomera to test release, separation and scatter. By then, the RAAF had decided that only the F-111 would carry the weapon, so operational test and evaluation flight trials were organised at the Aircraft Research and Development Unit (ARDU) starting in 1980 and continuing till 1983.

To ensure stores compatibility and adequate clearance, the RAAF instrumented A8-132 with a suite of sensors for telemetry tracking and fitted high-speed cine cameras to record all aspects of weapon carriage and release. The subsequent trials culminated in the successful clearance of *Karinga* on the F-111, but its development cost and schedule and its projected production cost, eventually combined with changing Defence policy, led to cancellation of the program in 1984. Consequently, the F-111C never carried cluster weapons of any sort.



RAAF

were a great success, and the RAAF recommended the purchase of further LGB kits for both Mirage and F-111 operations. Laser designators would be acquired separately for ground use.

Wing Commander Jules Wills on the Air Staff recalled that 'planning for LGB acquisition was stalled by the Department at every opportunity, so it took some years for the project to be approved'.<sup>96</sup> As luck would have it, the cancellation of the sale of HMS *Invincible* to the Royal Australian Navy in 1982 left a surplus in planned Defence expenditure for the year, and the LGB acquisition was sufficiently advanced to go through with Ministerial approval. A C-130 Hercules returning from Exercise *Bullseye* in Canada was diverted to Carswell AFB to collect the kits. Also on board the Hercules were four larger GBU-10 LGB kits, which were used to verify USAF clearance data, and to provide the F-111C with the capability to drop 2000-lb guided bombs as well as the usual 500-lb class of weapons. As yet, the F-111 had no self-designation capability. This would come with the incorporation of a laser designation and infra-red tracking system called *Pave Tack*, which was, however, still some years away.

**The Role of Defence Science**

Scientists and engineers at the Defence Science and Technology Organisation (DSTO) were vital to Australia's ability to support and maintain the F-111 fleet. Without their involvement, and to a lesser extent support from Defence industry, the RAAF could not have kept the aircraft in service for almost 40 years. It was therefore critical for the RAAF to establish a strong working relationship with numerous sections of DSTO to ensure the F-111 could be kept in service to 2010.

Work on aircraft fatigue was perhaps DSTO's most significant contribution in the early F-111 years, and this has been covered previously.<sup>97</sup> The knowledge gained and procedures developed also gave the RAAF an increased ability to manage the Mirage and Macchi life extensions, and enabled enlightened

decisions on future aircraft programs. It gave the RAAF as a customer a greater understanding of fatigue issues associated with the Mirage replacement, the F/A-18, and the C-130E Hercules replacement, the C-130J, as well as revealing some of the problems associated with the new technology of carbon fibre.

The Aeronautical Research Laboratories (ARL) was originally administered under the Department of Supply, but with the 1972 Tange Review, ARL became part of Defence making liaison with the Services somewhat easier. The Weapons Systems Research Laboratories at Edinburgh also played a major role by providing expertise on weapons trials and clearances. The work DSTO did to maintain the F-111 fleet as airworthy cannot be underestimated and the collaboration between their staff and the RAAF was critical. The work consisted of structural and fatigue studies, aerodynamics and flight performance studies, weapons and stores clearances, avionics and systems studies, human factors research, and computer modelling.

**Early Engine Problems**

One of the earliest collaborations between DSTO and the RAAF after the F-111 had entered service was associated with a problem that became known as Exhaust Nozzle Control (ENC) pump failure. The pumps worked under high pressure and supplied fuel to the engine nozzle control actuators that altered the vanes at the rear of the engine to direct the jet efflux. These pumps had to deliver hundreds of pounds of fuel under pressure to the actuators, so they needed to be robust. The Commanding Officer of No 6 Squadron, Wing Commander Ray Funnell, experienced an ENC pump failure airborne and, after an emergency landing, found he had less than 200 lb of fuel left in the tanks, as the rest had leaked away.<sup>98</sup> Technicians found structural cracking and failure of the pump casing caused fuel to flood the rear section of the aircraft, with the consequent fuel loss and serious fire risk. A method of early detection was needed to avoid grounding the fleet, together



with a determination of the cause of the cracking. Group Captain Ian Sutherland, Commanding Officer of No 482 Maintenance Squadron, approached ARL and discussed the problem with their mechanical engineering section. He later recalled how the problem was solved:

The cause was traced through a number of options and with the help of Sundstrand, the manufacturer, we found that the fuel we had been using had a very low lubricity rating. The solution was to add a fuel lubricant [called Hitec E-515] to the fuel which improved the lubricity and so reduced wear. ARL devised a wear test using different proportions of the additive and ran each through a pump fitted with an irradiated piston ring, and measured the rate of wear by the radioactivity of the effluent. That ratio of additive is still specially added to F-111 fuel as far as I know to this day.<sup>99</sup>

The innovative use of radioactive trace elements to detect wear was the first time the technique was tried in Australia.<sup>100</sup> It required the help of the Australian Atomic Energy Commission and the personnel at the reactor at Lucas Heights. Piston rings were irradiated at the reactor and fitted to the ENC pumps in a specially designed rig before measurements of radioactive leakage were taken. The success of the trials provided trouble-free ENC pumps for the life of the aircraft.

Shortly after the ENC pump failure problem was resolved, on 28 April 1977, F-111 A8-136 caught fire over Armidale, NSW, after a severe internal explosion. The throttles jammed, the right engine fire light illuminated and did not go out and, shortly afterward, the pilot lost control of the aircraft. The pilot, USAF exchange officer Captain Bill Baker, and navigator, Flight Lieutenant Dave Clarkson, successfully ejected. In its investigation, the Board of Inquiry found the probable cause to be an engine bleed duct failure causing very hot, high pressure air to start the fire.<sup>101</sup> Eighteen months later, on 25 October 1978, F-111 A8-141 suffered a wheel well fire over Auckland Harbour and the crew of Wing

Commander Dave Rogers and Squadron Leader Pete Growder successfully ejected. Again, the Board of Inquiry found that ‘the evidence pointed to a 16th stage bleed air duct failure in the wheel-well.’<sup>102</sup>

At this juncture, DSTO were called in to investigate. They suspected fatigue cracking of the bleed air duct, which was later confirmed, and found it to be a consequence of a poor joint weld inside the duct assembly. DSTO Materials Division engineers, using the new science of fractography,<sup>103</sup> calculated the rate of crack growth and established a safe inspection regime, while General Dynamics, and engine manufacturer Pratt & Whitney, developed a replacement part. Thirty new ducts were fitted, but these too had significant welding flaws. Between 1980 and 1982, twelve urgent investigations were carried out by DSTO. This resulted in the replacement of the American manufactured ducts with items manufactured locally by the Commonwealth Aircraft Corporation. The indigenous ducts were redesigned by DSTO to minimise stress concentrations and hence lessen the propensity to crack.<sup>104</sup>

**Boron Doubler and Adhesive Bonding Repairs**

From 1965, General Dynamics experimented with advanced composite materials for aircraft structures and repairs. These materials were lighter and stronger than the metal they would soon replace. One such material, boron fibre, consisted of boron filaments embedded in an epoxy resin backed with glass cloth. It was found to be ideal for aircraft structural strengthening and repairs.<sup>105</sup> DSTO’s experience with boron fibre, as a material of high strength and light weight that could be bonded to aircraft metal surfaces to spread loads and increase effective fatigue life, had its genesis with the USAF WPF repairs in the late 1960s. General Dynamics had first used boron doublers to strengthen the lower plate of the WPF which had caused the December 1969 crash and grounded the fleet. Consequently, when in 1977 extensive areas of the metal panels on the RAAF F-111’s horizontal stabilisers needed re-bonding due to delamination, DSTO scientists were able to assist



DSTO

**Above**  
Boron-epoxy doublers attached to a wing pivot fitting

**Below**  
The ARL wind tunnel model of the F-111 used to examine intake airflow problems.

as they established a repair regime and developed in-house expertise to remedy the problem.

Further work in the late 1980s saw the production of 40 boron doubler reinforcements for the 21 remaining F-111 aircraft, to stiffen a section of the WPF where it joined the wing. These boron doublers were re-installed between September 1990 and July 1995 giving the fleet a further life extension of 20 years.<sup>106</sup>

**Aerodynamic Modelling of F-111 Performance**

The arrival of the Australian F-111 without satisfactory performance data was another significant challenge faced by the RAAF. General Dynamics had simply adapted USAF F-111A and FB-111A data in an effort to suit the Australian requirements. While General Dynamics were contracted to produce flight manual performance graphs and data for the simulator aerodynamic performance algorithms, no F-111C test data was available and the USAF data was never fully representative. Squadron Leaders Ron Green and Gil Moore had conducted range and single-engine performance trials to confirm the aircraft could be ferried to Australia pre-1973, but

no formal flight test program had been conducted in the US before delivery. From 1972, ARL worked on a mathematical model to further refine the F-111 performance and dynamic behaviour data to allow better predictions for weapons clearances. The variable sweep wings and intricate engine intakes complicated matters, so wind tunnel tests commenced to establish a more representative database. A one-thirtieth scale F-111 intake model and 1/55<sup>th</sup> scale transonic wind tunnel model of a complete F-111C were specifically manufactured to high precision and provided the basis of the ARL work.

Engineers at DSTO, principally under Colin Martin, began to construct a three-degrees-of-freedom mathematical model in the late 1970s of the dynamic behaviour of the F-111C. Sampling flights were organised at Amberley in 1977 to gather actual data, but the anticipated one-year program eventually took 10 years to complete.<sup>107</sup> Part of the difficulty lay with the F-111’s unique adaptive flight control system. The adaptive flight control system was designed to automatically compensate for air turbulence and changed flying conditions when operating close to the ground—the F-111’s intended environment. No other analogue aircraft used an adaptive feedback system and, by the early 1980s, digital systems replaced the analogue. Digital flight controls were ‘design, develop and forget’ and could



DSTO

be easily modelled, whereas the analogue system used complex mathematical equations and required validation through measurement of actual in-flight conditions.<sup>108</sup>

The F-111 changed the nature of ARL research into aerodynamics from wind tunnel testing and theory to the development of much broader capabilities, such as loads assessment, performance prediction and operational research.<sup>109</sup> DSTO extended its research to produce a six-degrees-of-freedom mathematical model to predict the behaviour of weapons when released, and developed load spectra used in fatigue testing. To accomplish the task, ARDU instrumented A8-132 and fitted a longer nose section to accurately measure aircraft speed, pitch and yaw. The tests ran over 11 flights between September and October 1987, including a supersonic run, to gather the necessary data.

The developmental work allowed the RAAF to become a smart customer. The aerodynamic model was eventually provided to simulator manufacturer, Wormald, for the replacement simulator project at considerable saving and to ensure the flight dynamics of the simulator were truly representative of the aircraft.

**A Political Crisis – The Franklin Dam Affair**

Early in the afternoon of Thursday 7 April 1983, a RAAF Mirage took off from Avalon airfield near Melbourne on a mission that would have deep political repercussions and change the way the Australian Defence Force (ADF) would be tasked by the Government in future.

The first sitting of the Senate for the Thirty-Third Parliament in April 1983 was to be a torrid session for the incoming Hawke Government. After convening on 21 April, and after the opening administrative pleasantries were concluded, the Opposition insisted on Question Time before any business was conducted. They immediately launched a stinging attack on the newly sworn-in Labor

Government and, in particular, on the Attorney-General, Senator Gareth Evans, over what became known as the Tasmanian ‘spy flights’ scandal or, more satirically, ‘the Biggles Affair’. Earlier in the month, Evans had independently ordered an RAAF F-111 reconnaissance mission to photograph the Gordon-below-Franklin Dam construction site, set deep in the wilderness region of south-west Tasmania.

The photos were to be used by the Government in their upcoming High Court case against the State of Tasmania on the Franklin Dam issue.<sup>110</sup> The dam project was the subject of a bitter struggle between the Tasmanian Liberal Government/pro-dam/hydro power lobby and the nascent Green<sup>111</sup>/anti-dam/anti-logging movement. The Hawke Government was elected on a platform, among other issues, of saving the wilderness—something the previous Fraser Government did not countenance. Tasmanian Premier Robin Gray took the pro-dam approach. He later recalled: ‘My Government was the first Tasmanian Liberal Government elected in its own right ... We were elected on a policy or commitment that we would build the Franklin Dam. It was a very important issue for us.’<sup>112</sup> It became an issue of States’ rights over the Commonwealth, and eventually set legal precedence.

The Federal Liberal Party were not prepared to interfere with States’ rights, particularly one run by the same party, nor were they reading public opinion on the emerging politics of the natural environment. Labor took the opposite stance on both issues. Political commentator Paul Kelly summed it up: ‘Labor was decisive while the coalition fell into a double trap – a constitutional defence of the states and an irresolute stance on the environment.’<sup>113</sup> Prime Minister Bob Hawke had come to power partly on votes won by supporting the South-West Coalition of conservation groups against the dam construction, so subsequently on election night, Hawke announced the dam would be stopped.<sup>114</sup>

Evans had ordered the RAAF overflight to gather evidence in support of the Commonwealth’s request

for a High Court injunction to stop Tasmania from building the dam.<sup>115</sup> As the Attorney-General, Evans believed he could order the reconnaissance flight directly. After recommendation by a deputy secretary in his Department, his staff contacted the operations staff at Air Force Office without seeking higher approval. The operations staff presumed the flight was authorised so tasked an RF-111 for the job, but an RF-111 was not available. Believing the photos were required urgently, the Air Staff re-tasked a Mirage instead. Because of poor visibility and low cloud, the Mirage made several high-speed, low-level

**Below**

One of the RF-111 shots of the Franklin Dam work. This is the contruction worker’s village at Warner’s Crossing taken from 30 000 ft.

passes over the site, but failed to get any satisfactory imagery. If it was meant to be a clandestine operation, nobody told the pilot. The display merely warned those on the ground and caused questions to be asked by both sides.

An RF-111 was then tasked the next day to complete the task. It took off from Amberley with external fuel tanks fitted, flew down to Tasmania, took the required photos at high level, and left relatively unannounced, returning to south-east Queensland without landing to refuel. The film was unloaded, processed and flown down to Canberra that day in another F-111, easily meeting the Senator’s deadline. According to the pilot, Squadron Leader Noel Furber, they ‘flew to Portsea and Queenscliff to take imagery of the Army Staff College as a cover and from there we went to the Franklin. Air Traffic Control were



82 Wing



right on to us ... the word was out so when we arrived, as I said, ATC was ready’.<sup>116</sup>

The word was out, so the story quickly made it into the papers, breaking in the *Sunday Telegraph* on 10 April. Gray accused the Federal Government of using the RAAF to ‘spy’ on his State, thereby raising the question of the Constitutional legality of the Federal Government’s actions. According to Gray:

The F-111 affair was one of the lighter moments of the whole issue ... The day the story broke, we were in Canberra for a Premier’s Conference. We got word of these fly-pasts from our mates in the workforce down on the dam site. I spent the whole night getting in touch with every newspaper to make the most of it.<sup>117</sup>

Evans found himself in trouble with Hawke and dragged Defence Minister Gordon Scholes into the melee, although Scholes only found out about the flights just before the event. Hawke was furious, as was the Chief of the Defence Force Staff (CDFS), Air Chief Marshal Sir Neville McNamara. Neither knew of the flights and neither was happy with the result.<sup>118</sup>

Another interested party was Bob Brown, the leader of the Tasmanian Wilderness Society, future Senator and leader of the Australian Greens. Brown raised other concerns about the overflights:

We viewed this [the flights] with a great deal of anguish because the matter was coming before the High Court. The flyover looked like a very clumsy political decision by the Attorney-General ... it would have just taken a phone call from the Attorney-General to me asking for aerial pictures. The purpose of these flights was simply to prove that works were proceeding on the dam and presenting proof to the Court. Any day of the week, I could have provided high quality close ups as we had extremely good photographers. I don’t think any single episode that year provided more work for cartoonists than that flyover.

However, it reinvigorated interest in the whole [dam] issue. It had gone off the boil because evidence was

being gathered by both sides for the monumental High Court case which was in the offing.<sup>119</sup>

It must have been a slow news week because the editors of *The Australian*, *The Sydney Morning Herald* and *The Age* newspapers found they had a great story and put it on the front page of their papers. The story ran for several days and it was national news.<sup>120</sup> It was picked up by political reporter, Laurie Oakes. During an appearance at the National Press Club in Canberra, Oakes asked Evans:

I am wondering how concerned or perhaps regretful you are that anything you now accomplish may be overshadowed by the Tasmanian spy flights and perhaps you will be known forever as ‘Biggles’ or eventually ‘Mr Justice Biggles’? ... Do you just fail to consider the political implications because you are new, or do you consider them terribly carefully and get them wrong?<sup>121</sup>

Evans later offered what he called the ‘streaker’s defence’—‘it seemed, your worship, like a good idea at the time.’<sup>122</sup> Evans admitted his staff called up ‘a friend in the RAAF’ to organise a single photographic overflight of the disputed region, to be completed by 8 April. Evans was expecting a single F-111 flight at about 30 000 ft, not a low-level beat-up by the Air Force. Group Captain Dick Waterfield, the Director of Air Operations, had received a phone call from the Attorney-General’s Department and tasked the aircraft, presuming it was cleared by the Minister and the Service Chiefs. Unfortunately, it was not. CDFS McNamara later wrote to wrote to CAS Air Marshal David Evans stating:

... in particular I am extremely concerned that the matter appears to have been handled as a routine task within your Directorate of Operations and authorization given without your or my knowledge. At the very least, this action demonstrates a lack of awareness of the political sensitivities and even deeper consequences of the use of Defence Force assets on an issue such as the Franklin River Dam.<sup>123</sup>

The matter was not allowed to lapse. Liberal Senator Durack launched a Parliamentary attack later that month. Durack asked: ‘When his bizarre escapade with RAAF spy planes flying over Tasmania became known to the public on Sunday 10 April, why did he [Evans] not, without delay, tell the people of Australia the whole truth about this bizarre event?’<sup>124</sup> The Attorney-General carefully deflected the questioning, but found he had inadvertently created the Government’s first major gaffe—not just because of the States’ rights issue. He had specifically drawn the ire of Hawke who, the following week, was holding a National Economic Summit, calling together the State Premiers, unions, welfare and business groups to discuss the country’s economic situation. According to reports, Hawke ‘conveyed his views “clearly and effectively” to Evans during morning tea at the summit on 11 April, and Evans was suitably chastised’.<sup>125</sup>

The dressing down was also not the end of the matter. Called into Estimates, Defence sought to defend the flights for their ‘training value’, as the focus of the inquisition had turned to cost, not the Commonwealth’s powers or Constitutional rights. At the time, the operating costs were quoted as \$3265 per hour for a Mirage and \$3941 per hour for an F-111, but the more significant issue of the ‘spy flights’ authorisation was let go.<sup>126</sup> The questions continued until June and, thanks to political commentator Laurie Oakes, the saga became forever known as the ‘Biggles Affair’, with Evans afterwards called ‘Biggles’ by the media and the Opposition alike.

As well as fostering Bob Brown’s political career with the Greens, the Franklin Dam issue resulted in a much tighter process for tasking RAAF aircraft. The relevant Defence Instructions for how and when the ADF could be used in Australia by the Government were first raised in 1978 and, as a result of this affair, went under full review. Ironically, the latest amendment to the ‘Defence Force Aid to the Civil Power’ instruction had only been issued on 6 April—bad timing indeed.<sup>127</sup> Subsequently, the orders were

amended such that a more formal and rigorous approval process must be undertaken and in the case of Aid to the Civil Power, the Governor General’s call out powers may be enacted.

After protracted challenges, it was the High Court of Australia that stopped the Franklin Dam in July 1983 and not Evans.<sup>128</sup> It was more than just a decision for the pro-Green lobby. The decision set precedence for the external powers of the Commonwealth over the States under the Federal system and changed the way the Australian democratic system operated. It saw the emergence of the Australian Green movement as a fourth political force, and the emergence of new and sophisticated political tactics. These included the use of high-profile British environmental campaigner, David Bellamy, as a marketing agent, the taking of a series of high quality photographic images of the pristine wilderness which were used in newspapers and magazines to sway public opinion, clever advertising using media industry consultants, targeted use of opinion polls, and peaceful protests which were covered by the TV media. From this action, the notion of a national park of world heritage significance emerged and entered the Australian consciousness.<sup>129</sup> Ironically, and in closing the affair, the High Court took the F-111 photos as evidence in its deliberations, but the Wilderness Society’s photos were deemed inadmissible ‘lest they inflame the mind of the court with irrelevancy’.<sup>130</sup>

**The First Decade**

The first decade of F-111 operations in Australia was one of implementation and discovery. Arriving 10 years late and after weathering the controversy, the aircraft finally entered the RAAF Order of Battle. After a number of ‘flag-waving’ flights and demonstrations, the F-111 force settled into a regular training and exercise routine, often providing the ‘enemy’ strike force, using Vietnam-era weapons and tactics. A long-sought after reconnaissance capability had been procured, but as yet a self-contained, precision weapon delivery capability was non-existent. More importantly, as the engineers



RAAF Museum

Above

Air Commodores Talbot and Funnell celebrate the F-111's 10th Anniversary in Australia, 3 June 1983.

consolidated their F-111 maintenance philosophy and began to understand just what F-111 ownership meant, the Air Staff began to examine strike doctrine and how the aircraft should be used. The RAAF also began to transition into a balanced and modern air force that would remain relevant to Government policy and the changing world environment.

Notes

- 1

John Stackhouse, 'Defence on the Move', in *Aircraft*, vol. 55, no. 10, July 1976, p. 20.
- 2

Air Marshal Alister Murdoch, 'RAAF Capability', in *Aircraft*, vol. 47, no. 12, September 1968, p. 27.
- 3

Royal Australian Air Force, Australian Air Publication 1000—*Royal Australian Air Force Air Power Manual*, RAAF Air Power Studies Centre, Fairbairn, 1990, pp. 32–38.
- 4

NAA: A7941, F14.
- 5

NAA: A7941,F14, COSC Minute 73/1971, 10 November 1971.
- 6

ibid., notes 24 November 1971.
- 7

Air Marshal James Rowland, 'Operational Effectiveness and Capabilities of the RAAF', in *Aircraft*, vol. 55, no. 3, December 1981, p. 16. Equipment programs were: a replacement fighter for the Mirage, a precision guided munitions capability for the F-111, and a maritime strike capability for the F-111 and P-3C.
- 8

Air Chief Marshal Sir Neville McNamara, interview, 20 April 2009.
- 9

OAFH, Air Board Agendum 1075, 26 February 1975 and 36/75, 29 May 1975.
- 10

OAFH, Air Board Agendum 36/1975; and 'New Fault in F-111s', in *The Sunday Mail*, 23 March 1975.
- 11

Wing Commander Tony Wilkinson, personal correspondence.
- 12

'Bird Strike Danger Reduced', in *RAAF News*, August 1975; Royal Australian Air Force, *Sifting Through the Evidence: RAAF F-111 and F/A-18 Aircraft and Crew Losses*, Directorate of Defence and Aviation Safety, Canberra, 2008, pp. 8–9. The first two trial windshields were fitted in 1975. After successful trials in Australia in 1976, the fleet was fitted as each aircraft went into major servicing. Unfortunately, on hitting a bird as large as a pelican at high speed, no windshield could guarantee to stop penetration.
- 13

Newham, interview, 8 February 2009.
- 14

ibid.
- 15

Whitehead, interview, 11 July 2008. According to Whitehead, the first Commanding Officer of 482 Squadron under the F-111 era stated: 'Industry wasn't a great deal interested in looking after 24 very complex aircraft'.
- 16

NAA: A7941, F14, 20 September 1967.
- 17

Whitehead, interview.
- 18

RAAF Queanbeyan Records Section, file A8/10/24.
- 19

Air Chief Marshal Sir Neville McNamara, interview, 20 April 2009.
- 20

Air Vice-Marshal Ian T. Sutherland, interview, 28 October 2009 and correspondence.
- 21

OAFH, Air Vice-Marshal Collins, RAAF Oral History Program interview, November 2007; Whitehead, correspondence.
- 22

Air Marshal Errol McCormack, interview, 17 May 2010.
- 23

Whitehead, interview, 11 July 2008 and personal papers.
- 24

'F-111 Deeper Maintenance', in *Boeing News Inprint*, October-December 2009, p. 7.
- 25

Whitehead, correspondence. A flyaway kit was a pre-packed set of spares and maintenance equipment that could be deployed to a bare operating base at very short notice.
- 26

'F-111C Maintenance at Independent Squadrons', 482SQN/3/1/Air Pt 1 (19), 8 December 1975. Whitehead papers.
- 27

The CASAC replaced the Air Board as the RAAF's most senior strategy and policymaking committee. The Air Board made collegiate decisions. The CASAC consisted of the Chief of the Air Staff (as Chair), with the Deputy Chief, and the Chiefs of Air Force Plans, Manpower, and Technical Services, and the Director-General of Supply. The Assistant Secretary for Resources Planning (a civilian responsible for funds management) was added later. The CASAC was an advisory body only, with CAS now solely responsible to the Minister. Its role was to formulate strategy, implement policy, and monitor and administer day-to-day RAAF operations and training.
- 28

OAFH, CASAC Agendum 26/76 and Proceedings, 26 May 1976.
- 29

OAFH, CASAC Agendum 1/79, 21 May 1980 and 33/80, 27 January 1981. This meant the following servicing schedule: C – 135 hours (5 days); D1 – 375 hours (15 days); D2 – 750 hours (25 days) and E – 1500 hours (15 weeks).
- 30

OAFH, CASAC Agendum 33/80, 13 October 1980. Talbot was assisted by Wing Commander John Macnaughtan (Eng), Wing Commander R.A. Jones (Equip), Squadron Leader T.J. Lane (Equip) and Flight Lieutenant R.J. Risson (Eng).
- 31

OAFH, CASAC Agendum 33/80. The deseal/reseal program is covered in Chapter 7.
- 32

OAFH, CASAC Agendum 33/80 Minutes, 27 January 1981.
- 33

OAFH, Air Board Agendum 107/72, 24 November 1972.
- 34

OAFH, Air Vice-Marshal Bill Collins RAAF Oral History Program interview, November 2007.
- 35

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 127, 24 March 1982, p. 1391.
- 36

Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 127, 29 April 1982, p. 2069.
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ibid., pp. 2070–2071.
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39 'F-111C Formation', in *RAAF News*, November 1973, p. 3.

40 Group Captain Keith Isaacs, 'The Most Meritorious Performance in the Air', in *Aircraft*, May 1974, pp. 18–21 and 50.

41 'F-111C Will Fly Round Australia', in *RAAF News*, vol. 16, no. 2, March 1974, p. 1; 'Jet Re-enacts Historic Pioneer Feat', in *RAAF News*, vol. 16, no. 3, April 1974, p. 1; and 'Around Australia', in *RAAF News*, vol. 16, no. 7, August 1974, letters, p. 3. There was some conjecture as to who took credit for the first jet flight around Australia. It was claimed by Funnell as going to a No 6 Squadron Canberra for a flight on 14 July 1955 in an elapsed time of 17 hours.

42 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 91, 31 October 1974, pp. 3212–3213 and 3219.

43 'Kangaroo One', in *RAAF News*, July 1974, p. 3; 'RIMPAC 75 Involved Four Nations', in *RAAF News*, April 1975, p. 3; 'F-111s add realism to Asian ACEx', in *RAAF News*, April 1977, p. 6; and 'And to RIMPAC 77 in Hawaii', in *RAAF News*, April 1977, p. 7. The *Kangaroo* series of exercises was held every two years and was Australia's largest peacetime exercise, initially involving Australia, UK, US and New Zealand forces. Exercise *Kangaroo 1* was held in 1974. The *RIMPAC* [Rim of the Pacific] exercises involved Australia, US, New Zealand and Canada in a maritime scenario.

44 OAFH, Air Vice-Marshal Collins, Oral History Program interview, November 2007.

45 Group Captain Bob Bennett, interview, 12 April 2010.

46 'First F-111C Training Course at Amberley', in *RAAF News*, vol. 15, no. 8, September 1973, p. 3.

47 Squadron Leader Rick O'Ferrall, correspondence, 4 August 2008.

48 OAFH, Dr A. Stephens, interview with Air Marshal J. Newham, 11 January 1994.

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50 NAA: A7942, D94 Part 10.

51 Wing Commander Martin Chalk, interview, 16 December 2009 and correspondence.

52 Ken Hooper, 'Cocos King fears base for F-111s', in *The Australian*, 30 June 1977, p. 3; and 'Cocos plot for F-111 base claim', in *The Courier-Mail*, 30 June 1977.

53 NAA: A1838, TS677/3/2.

54 Richard Witkin, 'McNamara Orders 3D F-111 Version: Reconnaissance is Mission – Bomber also Weighed', in *New York Times*, 4 December 1965, p. 15.

55 Adapted from Royal Australian Air Force, *Sifting Through the Evidence*.

56 Aircraft A8-139, A8-128, A8-127 and A8-291. *Sifting Through the Evidence*, pp. 16–22.

57 Chined tyres have a protruding flare (or chin) around the rim to deflect surface water sideways rather than up and into the engine intakes.

58 RAAF Queanbeyan Records Section, file A8/1/6.

59 U.S. Congress, Senate, Ninety-first Congress, second session; Committee on Government Operations, *TFX Contract Investigation (Second Series)*, 1970, Part 3, p. 165.

60 NAA: A5619, C40 Part 1.

61 *ibid.* Cabinet Submission 1078, 19 October 1965.

62 NAA: A1209, 1968/8852 Part 1, 4 July 1966; and A1209, 1969/9011 Part 3, 3 April 1970.

63 NAA: A5882, C010 Part 1.

64 Bland Mission Report.

65 Cabinet Decision 1275, 16 September 1969.

66 *ibid.*, Part 1, p. 77. F-111A 63-9776, aircraft No. 11 was the only aircraft converted.

67 NAA: A5882, C010 Part 2; and A7941, F14.

68 F-111A Aircraft Serial No. 63-9776 was later re-serialised 66-0022 as a memorial to the first F-111 combat crew loss in Vietnam during *Combat Lancer* – 28 March 1968.

69 Thornborough and Davies, *F-111: Success in Action*, p. 79.

70 NAA: A5931, CL1030. The same document noted the expenditure on the F-111C as \$274.0m with \$21.5m still to pay.

71 Contracted date was 31 December 1974.

72 Air Marshal Errol McCormack, interview, 17 May 2010.

73 Stackhouse, 'Defence on the Move', p. 20.

74 Hugh White, interview, 6 May 2010.

75 OAFH, CASAC Submission 37/77, 29 April 1977.

76 OAFH, CASAC Agendum 37/77, 29 Aril 1977.

77 Alan Underwood, "'Seeing eye" pods for our blind F-111s', in *The Courier Mail*, 8 January 1977, p. 5; and 'More F-111s Possible', in *The Canberra Times*, 5 January 1977, p. 1.

78 OAFH, Air Board Proceedings, 17 May 1977; and Air Commodore Bob Kee, correspondence, 9 September 2009.

79 Wing Commander Frank Grimshaw, interview, 8 October 2008 and correspondence.

80 'Bird Returns to its Nest', in *RAAF News*, vol. 20, no. 11, December 1978, p. 5.

81 KA-56 – low altitude panoramic camera providing 78°–180° coverage; KA-93 – high altitude panoramic camera with four independent scan angles; and KS-87 vertical/split, vertical camera with variable coverage as preset. Royal Australian Air Force, Australian Air Publication 7214.003–1(AM1)—*Flight Manual F/RF-111C*, sect. 1, chap. 10, No 82 Wing, Amberley, 18 December 2006; and data from J.W.R. Taylor (ed.), *Jane's All the World's Aircraft, 1980-81*, Jane's Publishing Company, London, 1980, p. 345. Group Captain R.A.

Kee, 'Recognition of aerial photography', in *Triad*, no. 13, Autumn 1979, pp. 6–8, gives a basic description.

82 Air Commodore Bob Kee, correspondence, 9 September 2009.

83 'F111C returns', in *RAAF News*, October 1979, p. 3; and 'Highest Cost Warplane', in *News Release*, RAAF PRO, Kangaroo Point, 23 August 1979.

84 The Mk 80 series bombs were American and were numbered according to their weight: Mk 81 – 250 lb; Mk 82 – 500 lb; Mk 83 – 1000 lb; and Mk 84 – 2000 lb.

85 NAA:7491, F14. A paper entitled 'F-111 Strike Capability' by Group Captain H.A. Hughes noted that, to meet the strategic strike policy, the aircraft only had the Mk 82, Mk 84 and M61 gun, and that the RAAF was considering acquiring the *Karinga* cluster munition.

86 OAFH, Air Board Agendum 104/73.

87 Discussions with a number of staff who were Operational Requirements – Strike Reconnaissance (ORSRECON) or Operational Requirements – Weapons (ORWPN), including Wing Commander Lance Halvorson, Wing Commander Bob Howe, Wing Commander Bob Downing, Group Captain Peter Ekins and author's personal experience as ORSRECON1. Also White, interview, 6 May 2010.

88 OAFH, Air Board Agendum 79/75.

89 This point is emphasised in Stephens, *Going Solo*, p. 390.

90 RAAF Queanbeyan Records Section, files A8/33/5, A8/33/6 and A8/33/12; and OAFH, Air Board Submission 10/67, 14 February 1967.

91 Group Captain Peter Ekins, correspondence.

92 The Guided Bomb Unit (GBU) was the later term applied to the LGB kits. RAAF F-111s used Mk 82 and Mk 84 bombs, and GBU-10, GBU-12 and GBU-28 guided weapons.

93 TTCP is a five nations technical information exchange program. The five nations are the US, Great Britain, Canada, Australia and New Zealand. Originally called the Tripartite TCP when established in the 1950s, Australia joined in 1965 and New Zealand in 1969.

94 John Wisdom, *A History of Defence Science in Australia*, Defence Science and Technology Organisation, Melbourne, 1995, p. 155.

95 OAFH, Major Equipment Proposals FYDP 1980–81 – 1984–85, CASAC Agendum 31/79, 11 July 1979.

96 Group Captain Jules Wills, interview, 14 December 2009.

97 See Chapter 4.

98 Air Marshal Ray Funnell, interview, 25 May 2010.

99 Air Vice-Marshal Ian Sutherland, interview, 28 October 2009 and correspondence.

100 Bland, *A History of the First Fifty Years (1948–1990) of Support to the RAAF by Materials Scientists and Technologists in Aeronautical Research Laboratories at Fisherman's Bend*, p. 125; *ARL Annual Report 1975–76*, Australian Government Publishing Service, Canberra, 1977, p. 32.

101 Royal Australian Air Force, *Sifting Through the Evidence*, 2008, p. 6.

102 *ibid.*, p. 10.

103 Fractography is the study of fracture surfaces of materials, and is used to determine the cause of failure in engineering structures.

104 Bland, *A History of the First Fifty Years (1948–1990) of Support to the RAAF by Materials Scientists and Technologists in Aeronautical Research Laboratories at Fisherman's Bend*, pp. 125–126 and 132–133; *ARL Annual Report 1978–79*, Australian Government Publishing Service, Canberra, 1982, p. 48.

105 M.S. Howeth and B.C. Cornelius, 'Advanced Composite Production', p. 4.

106 Peter Chalkley and Rowan Geddes, *Service History of the F-111 Wing Pivot Fitting Upper Surface Boron/ Epoxy Doublers*, DSTO-TN-0168, Defence Science and Technology, Melbourne, 1998.

107 Colin Martin, interview, 31 July 2008; and *ARL Annual Report 1976–77*, Australian Government Publishing Service, Canberra, 1978, p. 41.

108 Martin, interview.

109 *ibid.*

110 'Commonwealth v Tasmania ("Tasmanian Dam case") [1983] HCA 21; (1983) 158 CLR 1 (1 July 1983)', Case 21, High Court of Australia, 1 July 1983. Cited from <http://www.austlii.edu.au/au/cases/cth/HCA/1983/21.html>, accessed 20 September 2009.

111 Then called the Tasmanian Wilderness Society.

112 The Hon, Robin Gray, interview, 31 July 2009.

113 Paul Kelly, *The End of Certainty: The Story of the 1980s*, Allen & Unwin, St Leonards, 1992, p. 528.

114 Susan Ryan and Troy Bramston (eds), *The Hawke Government: A Critical Retrospective*, Pluto Press, North Melbourne, 2003, p. 176.

115 Keith Scott, *Gareth Evans*, Allen & Unwin, St Leonards, 1999, p. 121.

116 Noel Furber, correspondence, 28 August 2009.

117 The Hon. Robin Gray, interview, 31 July 2009. 'Gray accuses Hawke of ordering spy flights over Franklin', in *The Age*, 11 April 1983, p. 3; 'Franklin: now Hawke sends in the RAAF', in *The Sydney Morning Herald*, 11 April 1983, p. 3; 'Amberley F-111 in Secret Spying Mission', in *The Courier Mail*, 14 April 1983.

- 118 Air Chief Marshal Sir Neville McNamara, interview, 20 April 2009.
- 119 Senator Bob Brown, interview, 18 August 2009.
- 120 Peter Dwyer, 'RAAF plane 'spied' on dam – Gray', in *The Australian*, 11 April 1983, p. 1; 'Hawke vetoes aerial watch on dam site', in *The Australian*, 12 April 1983, p. 1; Richard McGregor, 'Franklin: now Hawke sends in the RAAF', in *The Sydney Morning Herald*, 11 April 1983, p. 3; Patrick Walters, 'Ministers censured over dam surveillance', in *The Sydney Morning Herald*, 12 April 1983, p. 1; Patrick Walters, 'Air Force made two flights over dam site', *The Sydney Morning Herald*, 14 April 1983, p. 2; 'Gray accuses Hawke of ordering spy flights over Franklin', *The Age*, 11 April 1983, p. 3; 'PM bans RAAF dam "spy" flights', *The Age*, 12 April 1983, p1.
- 121 Scott, *Gareth Evans*, p. 122.
- 122 Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S.98, 21 April 1983, p. 959. The 'streaker's excuse' entered the lexicon on Easter Sunday 1974 when a couple were caught streaking at Sydney's Royal Randwick Racecourse during the Doncaster Handicap—their excuse: 'it seemed like a good idea at the time'.
- 123 Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S.98, 21 April 1983, pp. 72 and 911; and Air Chief Marshal Sir Neville McNamara, interview, 20 April 2009.
- 124 Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S.98, 21 April 1983, p. 26.
- 125 Scott, *Gareth Evans*, p. 121.
- 126 Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S.98, 21 April 1983, p. 1106.
- 127 The relevant Defence Instructions (General) were: DI(G) OPS 05–1—*Defence Assistance to the Civil Community—Policy and Procedures*; and DI(G) OPS 05–2—*Defence Force Aid to the Civil Power*. DI(G) OPS 05–1 was amended to include a new section on non-emergency assistance to civil authorities, such as government departments. DI(G) OPS 05–2 was cancelled and a new DI(G) OPS 01–1—*Defence Force Aid to the Civil Power—Policy and Procedures* was issued.
- 128 On 1 July 1983, the High Court of Australia sitting in Brisbane voted 4-3 in favour of giving the Commonwealth power to override the Tasmanian Government's hydro-electric dam proposal.
- 129 Paul Carter, '25 years on, the green message is flowing', in *The Canberra Times*, 30 June 2008.
- 130 Senator Bob Brown, interview, 18 August 2009.



# 6. APPLICATION

## 1983–1993

*I always thought the F-111s were a very valuable component of our air capability.*

The Hon. Kim Beazley, Minister for Defence

Nice as it was to have an impressive new aircraft in the inventory, the RAAF soon realised it faced three challenges: first, managing the asset; second, getting ‘smart’ weapons to arm the asset; and third, keeping the asset relevant in changing strategic circumstances. Once the F-111 strike force became a strike reconnaissance force, the RAAF turned its attention to keeping the fleet up to date. The inclusion of a precision targeting system, an attrition buy and an avionics update were the next major projects. As well as updates, working out how best to apply the aircraft in Australia’s region was also challenging. This period is considered the application phase, a time that also heralded a series of Defence reviews which changed how the RAAF was supported. This chapter examines the impact on the RAAF of keeping the aircraft relevant to both the defence strategy and the air battle. It concludes with a review of the fuel tank deseal/reseal program that caused medical problems for maintenance workers, and how the RAAF managed the consequences.

### Enhancing Strike Capability

There are four ways to enhance strike capability on any given platform. First is by incorporation of precision guided munitions or PGM. Use of PGM reduces collateral damage and it means fewer weapons and sorties per target. Second, the electronic warfare equipment, avionics and navigation systems can be upgraded for self protection, accuracy, redundancy and extension of

their time between maintenance. Third, the aircraft’s performance can be improved by incorporation of better engines, more responsive flight controls, extensions to fatigue life and streamlining to reduce drag. Fourth is the incorporation of an air-to-air refuelling capability. Only the first three methods would be applied to the Australian F-111 fleet.

The process of enhancement and upgrade was thus continuous from the early 1980s. A decade earlier, the Air Staff realised the aircraft would need to be complemented by a suite of weapons and electronic self-protection systems suitable for Australia’s regional strategic environment. They developed projects to fill the capability vacuum. Such projects took time to progress and had to fit the Department’s strategic policy directives and the Defence budget, as well as competing with other Service requirements. For the RAAF, these included an attrition buy, acquisition of the *Pave Tack* precision targeting system, and the Avionics Upgrade Program (AUP).

### F-111A Attrition Buy

The idea of acquiring additional F-111s was first proposed by Air Vice-Marshal David Evans when he was Chief of Air Force Operations in May 1977. In July, the idea was floated with the USAF during the annual airman-to-airman talks.<sup>1</sup> The USAF supported the motion, so the Air Staff raised a formal statement of requirement and bid for funding. ‘Project Air 59 – F-111C Attrition Aircraft’ was

created to progress the purchase, with a year of decision set for 1981–82.

By 1980, the original 24 F-111Cs had been reduced by four due to accidents. Fortunately, as an attrition buy was within the scope of the original purchase arrangement, reiterated under the 1970 Fraser-Laird agreement, the Government was persuaded to acquire four ex-USAF F-111As. These would come at the 1964-capped price of \$5.95m each, a bargain given inflation and the inclusion of so many modifications. Although the four aircraft cost \$23.8m, their preparation, Cold Proof Load Test (CPLT) and upgrade to C-model status forced the cost to \$60m, but the modifications were easily implemented and delivery was quickly organised.

Once funding had been approved, a RAAF engineering team travelled to the US to select the best aircraft for purchase, but the story broke in *RAAF News* before any deal had been struck.<sup>2</sup> Although it appeared relatively simple to select four airframes still in operational service, preparing them for the RAAF was another matter. The four were selected from the flight line of the 366th Tactical Fighter Wing at Mountain Home AFB, Idaho. However, on 23 November 1981, the Chief of Air Force Technical Services, Air Vice-Marshal Tony Dietz, advised the CAS weekly meeting that during a CPLT, one of the selected F-111A’s wings had broken. This caused a flurry of activity and investigations by both the RAAF and USAF.<sup>3</sup> Eventually, two aircraft (67-0106 and 67-0108) failed the CPLT, so two other aircraft were substituted from the same source. The two that failed CPLT were returned to the USAF, but after retirement to the Aerospace Maintenance and Regeneration Center (AMARC), called ‘the boneyard’, they were held for possible later use by the RAAF.<sup>4</sup> One (67-0106) was acquired in November 1999 and shipped to DSTO at Fisherman’s Bend in Melbourne for tear down inspection and testing. Having a complete test aircraft allowed Australian scientists to better understand the design and structure of the aircraft, and to trial new inspection techniques.



Author

**Above**  
F-111A A8-114 acceptance ceremony at McClellan AFB, complete with dancing girls ‘Sizzling Hot’, 8 April 1982. Captain Bob Lawyer (USAF exchange), Deanna, Kim, Rachelle, Diane and Flight Lieutenant Mark Lax.

After selection, the aircraft were fitted with extended ferry wingtips and serviced at the Sacramento Air Logistics Center at McClellan AFB before being ferried across the Pacific by RAAF crews. Unbeknown to most in the RAAF, the project engineer, Wing Commander Paul Welsh, had the first aircraft, A8-114, emblazoned with the name ‘Sizzling Hot’, and organised the dancing girl troupe, from which 114 took its name, present for the handover. After the dancing girls had left the hangar floor, the formalities of acceptance began.

The four aircraft were flown to Australia between 1982 and 1983, and later converted to C-model status at No 3 Aircraft Depot, although they retained the original A-model WCTB and some avionics.<sup>5</sup> The main delay to full conversion was the 36-month lead time for the acquisition of four sets of heavier landing

Table 6–1: RAAF F-111A Data

Aircraft Type	RAAF Serial Number	GD Block No & USAF Serial No	First Flight	Delivery/ Acceptance	Arrival in Aust.
F-111A	-	A1-03 / 63-9768	30 April 1965	-	Shipped 1998
	-	A1-151 / 67-0106	-	-	6 November 1999
	-	A1-153/ 67-0108	Held in the US		
F-111A – F-111C	A8-109	A1-154 / 67-0109	15 July 1969	13 August 1982	20 August 1982
F-111A – F-111C	A8-112	A1-157 / 67-0112	22 July 1969	13 August 1982	15 January 1983
F-111A – F-111C	A8-113	A1-158 / 67-0113	14 August 1969	1982	23 May 1982
F-111A – F-111C	A8-114	A1-159 / 67-0114	6 August 1969	1982	23 May 1982

(Sources: NAA: A10297, Block 469 – Aircraft Status Cards – F111, A8-126 to A8-141 (with gaps); AAP 7214.016 – F-111 Type Record; www.f-111.net)

gear.<sup>6</sup> The additional four aircraft brought the RAAF up to its original 24 F-111 aircraft strength and provided more aircraft on the flight line, which was important because the fleet was about to undergo a significant upgrade—the incorporation of a precision targeting system called *Pave Tack*.

**The *Pave Tack* Project**

One of the key F-111 deficiencies identified early on by the USAF and RAAF air staff was the lack of precision in both targeting and weapons delivery. The later years of the Vietnam War had proven the utility of both laser and TV-guided weapons with the deployment of the *Pave Spike* system used by F-4 aircraft in the late 1960s.<sup>7</sup> In 1974, the USAF Aeronautical Systems Laboratories at Wright-Patterson AFB issued a request to industry to develop a self-contained laser system for combat aircraft. Ford Aerospace won the US\$15m development contract and, after production of a prototype, began flight testing on F-4s in 1976. Their *Pave Tack* system

was a success and trials were extended to the USAF’s F-111Fs between September 1977 and August 1978. Using *Pave Tack*, accuracy improved 2.5 times for toss deliveries and guided weapons were nearly all direct hits.<sup>8</sup> The USAF ordered the system and the first production pod rolled out of the Ford plant on 30 August 1979.<sup>9</sup> By the early 1980s, the USAF had committed to acquire 149 pods for their F-111Fs, F-4Es and RF-4Cs, and these later proved their worth in operations against Libya and in the Gulf.<sup>10</sup>

RAAF interest in *Pave Tack* began when Squadron Leader Bob Howe was posted to RAAF Washington in 1973. As a staff officer responsible for monitoring USAF aircraft and weapons developments, he took an interest in the development of *Pave Tack* when he met its USAF originator, Major John Ruffing. Ruffing was known among his contemporaries as ‘Pave’ and the pair became good friends. Ruffing passed away before *Pave Tack* became operational, but he sowed the seeds of an idea. Howe sent as much data back to Australia as he could so that the Operational





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**Above**

An aircraft carrying four GBU-12s shows off the *Pavé Tack* pod.

Requirements staff could develop the idea further. In 1978, Howe left the RAAF but he continued to write about the precision guided munitions revolution, and the need for systems like *Pavé Tack* for the F-111 in the hope that someone in the RAAF would act.<sup>11</sup>

The AN/AVQ-26 *Pavé Tack* system gave the F-111Cs a much needed capability boost in weapons delivery precision. Advanced weapons, such as Harpoon and the GBU-15 2500-lb class electro-optically guided glide bomb, could be incorporated in the inventory. The *Pavé Tack* system consisted of a rotatable

forward looking infra-red (FLIR) sensor, a laser range finder and target designator, and the associated electronics, all enclosed in a self-contained, 1300-lb bullet-like pod, which was rotated into the weapons bay when not in use.<sup>12</sup> A digital interface for the analogue avionics was incorporated and a new video display for the attack radar and *Pavé Tack* images was fitted to the navigator's cockpit, together with an improved stores management system and a tracking controller. The camera head could be swivelled through an arc of 180° that allowed full forward, side and rearwards target observation, regardless of aircraft direction. A stabilised image in the navigator's display permitted the operator to switch between the radar and infra-red picture, and to designate the desired bomb impact point.

The combination of radar-IR tracking and laser designation allowed for better stand-off weapons delivery, and thereby reduced the risk of exposure when attacking heavily defended targets. An added benefit of accuracy was the reduction in both the number of attacking aircraft and weapons needed per target—a significant advantage given Australia's limited F-111 resources. In many situations, immediate post-strike analysis was also possible using onboard video recording, negating the need for later reconnaissance.

The RAAF sought data from the USAF *Pavé Tack*–F-111D/E/F project as early as 1976, but did not develop *Pavé Tack* into a formal program for several years. By 1979, the Operational Requirements – Strike Reconnaissance staff position was filled by Wing Commander Alan Lockett, and later by Wing Commander Lance Halvorson, F-111 navigators who recognised the advantages *Pavé Tack* offered. Of the project's beginning, Lockett recalled:

I had visited the US in 1979 and, among other things, brought back some video taken on USAF *Pavé Tack* trials. This video was subsequently shown by me to the then Minister for Defence, Jim Killen, as part of the process being followed to gain approval for the *Pavé Tack* project. Killen liked what he saw.<sup>13</sup>

Halvorson also appreciated the flexibility *Pavé Tack* offered:

The claimed capability by the manufacturer, Ford Aerospace, to be able to install *Pavé Tack* or return the F-111 weapons bay to its pre-*Pavé Tack* configuration in less than eight hours was significant in the decision, as the RAAF was unlikely to acquire sufficient items for all aircraft. The flexibility for reversion to the M61A1 [gun] and fuel tank configuration of the weapons bay was important for the roles of the F-111C.<sup>14</sup>

Defence Minister Killen, was suitably impressed and eventually a A\$160m project called 'Project Air 65 – Target Acquisition and Tracking System' was

approved in July 1980, when Killen announced a Letter of Offer and Acceptance. The letter allowed for conversion of the remaining F-111C aircraft, but as Halvorson had predicted, only 10 weapons bay pods and 20 cradles were to be acquired. The intention was to wire all F-111C aircraft and fit pods as necessary. Project Air 65 later became known as *Pavé Tack*/Guided Weapons and it included provision for the carriage of modern, externally mounted electronic countermeasures pods in addition to the laser and electro-optically guided weapons mentioned previously.

After completion of a Project Definition Study by Wing Commander Alf Jaugietis in August 1981, a Project Office was established at the Systems Project Office at Wright-Patterson AFB. Two engineers, Wing Commander Bob Bennett and Squadron Leader Gary Hollindale, set up the office, but were soon joined by navigator, Squadron Leader Martin Chalk, and another engineer, Flight Lieutenant Jeff Walsh. As *Pavé Tack* would be acquired under the US Foreign Military Sales program, a USAF civilian, Eugene Harvey, was designated as Project Director.<sup>15</sup> While the USAF was responsible for contract negotiations, the RAAF was responsible for operational, test and engineering aspects. Another small team was established at GD/FW under the leadership of Flight Lieutenant John Monaghan.<sup>16</sup>

The major problem faced was that the digital *Pavé Tack* had to be mated to an analogue F-111, so an Analogue Interface Unit had to be developed. This was completed by General Dynamics engineers with help from British Aerospace Australia staff who were involved as part of the Australian content requirement of the contract. The aircraft selected as prototype was A8-138 which was flown to General Dynamics in late October 1983. The modification work commenced in December, and by May 1984 a flight test crew had arrived. Together with a secondary crew, they commenced training that enabled them, in turn, to train crews back in Australia. According to Flight Lieutenant Greg Fitzgerald: 'The initial stages of the flight test phase





Chalk

**Above**

US Government Management Team for the Australian *Pave Tack* Program.

L-R: Flight Lieutenant Jeff Walsh, Squadron Leader Martin Chalk, Major E. Harrison (Canadian Exchange), Flight Lieutenant Gary Hollindale, Mr Eugene Harvey (USAF), Flight Lieutenant Bob Downing, Mr R. Middleton (USAF), Mr L. Gore (USAF), Mrs A. Telepak (USAF), Wing Commander Bob Bennett, Flight Lieutenant A. Stephan.

**Opposite**

Minister for Defence Kim Beazley gives the thumbs up after accepting the first *Pave Tack* aircraft. This earned him the nickname ‘Bomber Beazley’.

involved a number of special-to-purpose courses conducted by the various aerospace companies involved in the project: General Dynamics, McDonnell Douglas, Rockwell, Texas Instruments, General Electrics and Delex Inc.’<sup>17</sup>

Flight testing commenced after the *Pave Tack* had been fitted and ground checked. It was conducted in two phases: Flight Verification Phase (FVP) to shake down the system, and Performance Evaluation Phase (PEP) to determine how well the system worked. The first flight out of GD/FW was on 1 October 1984 and this phase lasted four months. PEP was conducted out of McClellan AFB and commenced on 26 February 1985. During this phase, practice bombs were dropped to gauge overall system performance and this culminated in the dropping of a GBU-12 guided bomb at China Lake Naval Weapons Center in California. Test flying was complete by 30 September 1985 and Australia finally had the accuracy the strike force required.

After the initial work on A8-138, the six-man Depot Modification Team that had been in Fort Worth returned to Amberley in January 1985 to establish the *Pave Tack* Section. The team provided



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the core of expertise to enable No 3 Aircraft Depot staff to undertake the 7000-man-hour *Pave Tack* modification, with company Field Service Representatives from the US on site for assistance.<sup>18</sup> The remaining fleet of C-models were modified at Amberley from 4 March 1985, commencing with aircraft A8-147. This aircraft was officially rolled out on 24 September 1985 to much fanfare, at a ceremony attended by the Minister for Defence, Kim Beazley.<sup>19</sup> All 20 F-111Cs were eventually modified, and all were fitted with pods once spares became available from ex-USAF F-111F stocks.<sup>20</sup> The project was completed on budget at US\$160m.

The *Pave Tack* system became the mainstay of F-111 strike operations, but the squadrons initially suffered from the lack of any knowledge on how to apply the capability to its full extent. There were no tactics or doctrine development cells in the squadrons, there were no operational manuals, and no RAAF member was considered an expert. Working out how best to use *Pave Tack* was left up to No 1 Squadron crews using trial and error, although some knowledge came from returning exchange officers who had flown *Pave Tack* aircraft in the US.<sup>21</sup> Regardless of crew inexperience, the *Pave Tack* system for the first time gave the RAAF a true all-weather, day-night precision strike capability. However, according to the *Pave Tack* flight test director, Wing Commander Bob

Downing, while ‘*Pave Tack* looked good politically, to those of us who actually understood the aircraft, [*Pave Tack*] without suitable stand-off weapons was useless.’<sup>22</sup> Weapons acquisition would thus be the next challenge, and the first deliberate by-product of *Pave Tack* was the introduction of Harpoon.

**Maritime Strike and AGM-84 Harpoon**

Perhaps the most important and effective role undertaken by the F-111 force was maritime strike. Although the USN had rejected the aircraft in 1968, it was not rejected as inadequate as a maritime strike platform. In fact, the USN intended to use the aircraft as long-range interceptor, not as a bomber, so its potential in the maritime environment was never fully considered by that Service.

Australia as a maritime nation relies on its sea lines of communication for trade and prosperity, so it made sense to reinforce the capability of the Royal Australian Navy (RAN) surface and subsurface fleet, and the RAAF P-3C Orion maritime patrol aircraft, with an F-111 maritime strike capability. The expanding number of possibilities for over-water strike that the F-111 now brought was not lost on the RAN either. Attacking enemy surface combatants was a prime role for the Navy and any assistance the RAAF could provide was welcome. A section of F-111s could clear a much wider arc of sea surface than the fleet, so in the early 1970s, Chief of the Air Staff, Air Marshal Colin Hannah, was asked by Admiral Sir Victor Smith to investigate the matter. Hannah’s positive response that the F-111 was well suited to maritime strike set in motion a new and important role for the strike force, but one that took over 10 years to deliver.<sup>23</sup>

Attacking heavily defended, high-value, naval warships is extremely dangerous and requires a long-range standoff missile capability for launch platform survival. Before the arrival of such weapons as the Harpoon missile, aircrews were expected to use a combination of tactics and ‘iron bombs’ to saturate the designated target. In the mid-1970s, this



consisted of coordinated multiple-aircraft strikes, with aircraft arriving over target from different directions at roughly the same time. The hope was that this would create enough confusion in the ship’s combat room that one or two aircraft would get through. The tactic was the best available, but suicidal due to the ship’s air defences, and it did not count on more than one naval vessel being in the vicinity at the time. The answer was to incorporate both the AGM-84 Harpoon and AGM-88 High-Speed Anti-Radiation Missile (HARM) on the F-111C. The Harpoon would sink the ship while the HARM would destroy its tracking radars and so prevent the ship defending itself. It was the late 1980s before the Harpoon was procured, but the HARM acquisition never eventuated despite full clearances being issued by ARDU for both weapons.<sup>24</sup> Unfortunately for the strike force, HARM was traded off in the Defence Committee for air-to-air missiles for the F/A-18 Hornets.<sup>25</sup>

The idea of using F-111s to attack surface vessels was not new. The RAAF had used the F-4 Phantoms in the maritime strike role and always intended to use the F-111Cs in similar fashion.<sup>26</sup> The Americans had looked at employing their F-111 aircraft in the surveillance and anti-shipping role because of its ‘good radar’, long range and low level capability. Weapons were a problem as no optical or laser-guided bombs had been cleared for F-111 use at that time, so ‘dumb’ bombs and special tactics were proposed. For these to be employed effectively without the attacking aircraft being shot down required a ‘toss bomb’ manoeuvre and considerable practice for both accuracy and safe escape.<sup>27</sup> In a discussion between Australian Prime Minister William McMahon and US Secretary for Defense Melvin Laird in November 1971, the option of a maritime strike role for the F-111 aircraft was first raised. Secretary Laird advised McMahon:

... that America was also building up its air capability in Greece and Turkey. In fact, they would be using the F-111 there in support of the naval presence in the

Mediterranean. This was a good role for the F-111. It was also the sort of role these aircraft could play in Australia.<sup>28</sup>

In the 1980s, the USAF eventually, and most reluctantly, adopted a secondary role of maritime strike called TASMO—Tactical Air Support of Maritime Operations—but it was never liked by the crews or the USAF hierarchy. Over-water operations were essentially USN business, but during the Cold War, the Pentagon planned to use the USAF as a Navy backup. Although Harpoon was never fitted to the USAF F-111 fleet, the provision of the ARDU clearance data meant that in a national emergency, the USAF could carry and fire the Harpoon (in bore-sight or line-of-sight mode only) without a lengthy and expensive flight trials program.

Harpoon is a 12.6-ft (3.8 m) long, turbojet-powered anti-ship missile with a high-explosive, blast warhead capable of cutting a warship in half. The 1145-lb (520 kg) missile can be launched in several modes—navigation, acquisition and attack—employing aircraft target data uploaded to the weapon before launch. Once fired, the missile flies autonomously to the target switching on its own homing radar in the final flight phase. Although the range remains classified, 70 kilometres is given in open literature, allowing the launch aircraft to remain beyond the target’s own surface-to-air missile engagement zone.<sup>29</sup>

For the RAAF, interest in Harpoon, at least for the P-3 fleet, formally began in 1977. Joint Project Brief 1 (JPB1) was raised as the first joint weapons acquisition program between the RAN and the RAAF. The Navy wanted an anti-ship missile for their submarines and surface fleet, the RAAF wanted the missile for the P-3s and, later, the F-111 and F/A-18 Hornets. Harpoon was the only missile available to meet all user requirements.<sup>30</sup> Fortuitously, with the incorporation of *Pave Tack*, came the opportunity to incorporate the Harpoon system controls and wiring. A new Harpoon control panel replaced the unused nuclear weapons panel in the F-111 cockpit.<sup>31</sup>



Layton

**Above**

A8-135 with Harpoon awaiting trials – 30 April 1988.

The F-111’s Harpoon weapon control panel was designed by Wing Commanders Peter Ekins and Lance Halvorson, and took into consideration all the Harpoon features. Such a panel did not exist at the time. Halvorson later recalled:

As the Australian F-111–Harpoon configuration was fully integrated, the navigator could program search patterns, set missile turn points and program target coordinates immediately before launch. This, together with other advanced features, made Australia’s F-111s fitted with Harpoon the most lethal conventional maritime strike platform in the world.<sup>32</sup>

Before further work was done on integrating the Harpoon with the F-111, DSTO Aeroballistics

Division was asked to model the missile and the F-111 for compatibility. The model indicated the weapons would fit at all wing sweep settings so, in 1980 when an F-111 was transiting through Point Mugu Naval Air Station, California, a trial ground fit was conducted on an inboard wing station to confirm the modelling results. More specific Harpoon trials began at ARDU and an aircraft was flown to the US Naval Weapons Center at China Lake, arriving on 5 July 1984 for two months compatibility trials.<sup>33</sup> The trials were successful, so 20 aerodynamically representative inert missiles, called Ballistic Air Test Vehicles, were acquired under ‘Project Air 58 – Guided Weapons’ and, after F-111C A8-132 was attached to ARDU, Harpoon carriage, flutter and drop clearance trials commenced in February 1985.<sup>34</sup> These continued until the end of March and a full flight carriage clearance was issued.<sup>35</sup> After the trials work at ARDU was completed, the first live



Layton

**Above**

The Harpoon firing team – NAS Barbers Point, Hawaii.

missile flights, using a Captive Air Test Missile, was conducted from Point Mugu over the Pacific Missile Test Range, off the southern California coast.<sup>36</sup>

To conclude the flight clearance, a fully telemetered Harpoon (without a warhead) was launched against a naval hulk on 21 August 1985. The launch was not just a straight-in shot. The crew programmed a waypoint into the missile to fully test the integration. Telemetry data was fed back to the Point Mugu Test Center and all went well until an internal missile failure caused it to crash just after turning at the waypoint. While the missile’s in-flight failure was a disappointment to the engineers and support crew, subsequent investigation showed that all aspects of the integration and launch of the missile from a project perspective had been successful, and that a technical fault in the missile was the cause of the in-flight failure. The maritime strike concept was proven and the F-111C had an important new role.

The live firing was not the end of Australian Harpoon system development. While it took another three years before the next live Harpoon firing, in the intervening period, the RAAF had developed a Harpoon Engagement Training Aid or HETA. The

HETA was a computer simulation tool used to train operational crews on the ground, reducing the need for expensive airborne practice. Even more useful was the DSTO-ARDU developed Captive Carriage Weapons Simulator (CCWS) which had Harpoon missile shape, weight and balance, and when fitted to the aircraft gave realistic training in missile procedures right up to launch. These two devices saved the taxpayer millions of dollars in US training and live firing costs, that otherwise would have been needed for crews to remain current.

The final confirmation of the successful integration of Harpoon onto the F-111C came during Exercise RIMPAC 88. As part of No 1 Squadron’s participation in the multinational exercise, a live firing was authorised inside the Barking Sands Pacific Missile Range facility off the Hawaiian coast. The Harpoon made a direct hit using a similar flight profile to the initial test mission.<sup>37</sup> Harpoon was now a proven capability.

**A Bigger Bomb?**

As well as the incorporation of *Pave Tack* and the GBU-10/12 series of laser-guided bombs, the RAAF also examined the option of acquiring the Rockwell GBU-15 2500-lb (1100 kg) class glide bomb. The bomb offered a stand-off advantage as it could glide

**Pave Tack and the *Pong Su***

With the advent of *Pave Tack*, laser tracking and self-designation became available and the RAAF sought to acquire further laser guidance kits for its Mk 82 and Mk 84 bombs already in inventory. Perhaps the most spectacular public demonstration of the accuracy of the weapons was the sinking of the North Korean drug freighter *Pong Su* off the NSW coast in March 2006. The vessel had been arrested for heroin importation by Australian Customs and Federal Police. After a protracted court battle, the vessel was towed 140 km out to sea and used as a target by an F-111 dropping two GBU-10s. The training sortie was a classic maritime strike profile, using a P-3 for strike direction and again illustrated the effectiveness of the F-111 in the maritime strike role and emphasised the bomb’s accuracy.<sup>38</sup> Video of the destruction and sinking of the vessel made news around the country.



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some distance and therefore provided greater aircraft survivability, particularly for the maritime strike role. According to Wing Commander Jules Wills who was responsible for weapons acquisition at the time, the GBU-15 was ‘*the stand-off weapon*’.<sup>39</sup> The GBU-15 had an optical target seeker in the nose and aerofoils on the fuselage and tail to allow the bomb to be steered to the target. The aerofoils provided added lift. A data-link pod fitted to the rear underside of the aircraft fuselage allowed the navigator to ‘fly’ the bomb to impact. Again, the *Pave Tack* system was necessary for the integration to succeed.

The RAAF had shown some early interest in the GBU-15 from mid-1976 when the manufacturers, Rockwell, made an unsolicited offer to the Air Staff to provide aircraft compatibility drawings and other data, but at the time, the RAAF F-111s had no way

of guiding them.<sup>40</sup> After *Pave Tack* was incorporated on the F-111, the Air Staff revisited the GBU-15 option. Consequently, in 1980, the RAAF formally sought price and availability data from Rockwell to see if integration was possible.<sup>41</sup> Fortuitously, trials in Europe in 1982 by USAF F-111Fs loaded with GBU-15s included four ‘live’ launches that resulted in four direct hits. Three bombs hit ground targets and the fourth, launched at Mach 1.4 from 22 000 ft sank a ship.<sup>42</sup> A year later the USAF declared the weapons operational.

The 15-mile (24 km) range of the bomb met the RAAF’s requirement for safe escape from defended targets. ARDU was tasked to conduct an extensive trial on the weapon as the F-111C’s longer wings made US trials data invalid due to differences in air flow. Trials began in March 1985 with a GBU-15





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**Above and opposite**

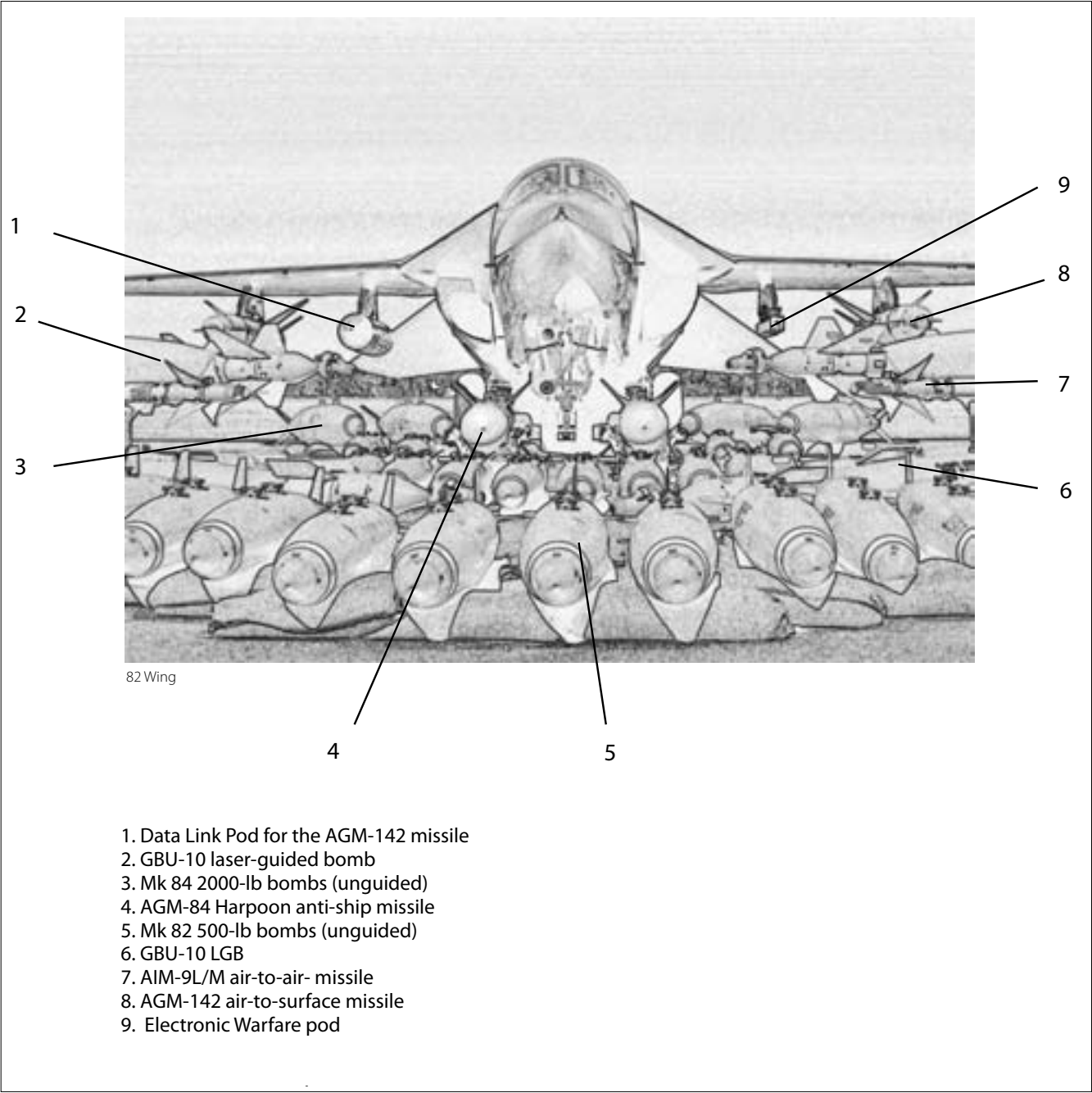
The weapon variety of the new century.

Mass Simulation Vehicle (MSV) which replicated the missile in dimensions, weight and balance. A restricted clearance was given after the successful drop of an MSV which allowed another test crew to conduct a telemetered bomb drop in the US.

The first Australian GBU-15 drop trials were conducted at the China Lake Naval Air Weapons Station in California using aircraft A8-138. Before the live release, the aircrew had to practice with an F-4 carrying a Captive Carriage Training Round while they ‘flew’ the bomb using *Pave Tack*. The targets were a set of painted dumpster bins inside the range

area. The release sortie was flown on 14 June 1985 and the weapon scored a direct hit.<sup>43</sup>

The live shot was not the end of the clearance program. As the GBU-15 was such a large weapon, the engineers believed that under certain flight regimes it could cause flutter in the aircraft wings and thus cause damage or even wing failure. Two Flutter Exciter Stores were built by DSTO that replicated the real weapon, but included telemetry and a mechanism controlled from the navigator station that, when switched on, would cause an imbalance in the store in an effort to excite wing flutter. The Flutter Exciter Stores did their job, but did not induce damage other than a tear in the horizontal stabiliser caused by a metal band on



- 1. Data Link Pod for the AGM-142 missile
- 2. GBU-10 laser-guided bomb
- 3. Mk 84 2000-lb bombs (unguided)
- 4. AGM-84 Harpoon anti-ship missile
- 5. Mk 82 500-lb bombs (unguided)
- 6. GBU-10 LGB
- 7. AIM-9L/M air-to-air missile
- 8. AGM-142 air-to-surface missile
- 9. Electronic Warfare pod

the store that snapped in flight and hit the tail. The tests continued until September 1987 and after the successful release of another MSV, the GBU-15 was cleared for F-111C operations.

Despite all the effort and expense, the GBU-15 was never acquired. The Harpoon missile replaced the GBU-15 as the weapon of choice for maritime strike, and more advanced missiles were emerging

for the land strike role. By the late 1980s, the RAAF began to show interest in an emerging Israeli design, the AGM-142, which offered much longer range than the GBU-15 and even greater accuracy. That development is covered in Chapter 7.

ARDU Flight Test Program

The role of ARDU during 1980s cannot be underplayed. Even before delivery in 1973, the aircraft had not been fully tested and aircraft performance and fatigue life were based on predictions. This led to extrapolations for flight manual data and very unsatisfactory tools for modelling of performance, and for weapons clearances. According to Squadron Leader Bill Collins, RAAF Resident Engineer at Wright-Patterson in 1968:

One of the things that amazed me was [that General Dynamics was] about to start delivering aircraft, not to Australia, but to the USAF during this time and yet major elements of the [*Combat Lancer*] deployment activity hadn’t even started. One major element was

ground structural testing of the airframe fatigue article. Another one was in-flight measurement of flight loads to compare them to the design calculations that had been done.<sup>44</sup>

The same applied to the Australian F-111Cs.

By 1979, the RAAF recognised it had its own set of flight testing requirements for the F-111C as it wanted new weapons, better performance data, and to be able to test new systems which would have otherwise cost millions of dollars. Such testing could only be conducted in America, and then only when the Americans were able to fit the Australian F-111s into their program. Consequently, aircraft A8-132 was dedicated for flight trials between 1979 and 1988. Collins continued:

To my mind [A8-132 became] the most valuable aircraft in the fleet because it was the aircraft used to clear new weapons that the Air Staff had determined had to be carried by the aircraft. Bear in mind we started off with iron bombs, which is not a really smart way of upsetting your enemy.<sup>45</sup>

In explaining why Australia, and specifically ARDU, had to conduct indigenous flight trials, test pilot and ARDU Commanding Officer, Group Captain Bob Richardson, wrote:

It is not well understood how different the RAAF F-111C aircraft is to its cousins in the USAF. As well as the longer wing which has markedly different aero-elastic damping and flutter frequency characteristics to the shorter wing versions operated with similar external stores by the USAF Tactical Air Command, the F-111C has different air intakes and overall aerodynamic flow fields to most of the other F-111 variants. Moreover, RAAF roles are different to TAC roles; for example, TAC has no maritime strike requirement, and required weapons and load configuration combinations are also different.<sup>46</sup>

Although the squadrons objected to having one twenty-fourth of their valuable assets out of operational hands, ARDU conducted over 30 Australian-unique F-111 trials and provided full, guided and unguided weapons clearances, numerous systems clearances, and helped develop a complete performance model. Table 6–2 lists the major trials conducted between 1979 and 1988, after which A8-132 was returned to the fleet.

Faith in the Aircraft

By the mid-1980s, some areas within the civilian side of Defence had begun to seriously question the validity of the F-111 in Australia’s Order of Battle, noting its high cost and lack of ‘use’ as reasons to reconsider its utility. The RAAF had to continually justify keeping its deterrent force and to explain why the F-111 was still relevant to modern air warfare. Two unrelated events convinced the Australian Government, the Defence bureaucrats

and the Australian public that keeping the F-111 was prudent. The first was the US raid on Libya and the second was the First Gulf War.

In the early morning hours of Sunday 6 April 1986, a bomb exploded in the La Belle Disco, a popular nightclub in the Schoenberg district of West Berlin. Two US servicemen and a Turkish woman were killed and 229 others were injured, some seriously. For US President Ronald Reagan, this terrorist attack followed a series of incidents against US servicemen and women and could not go unpunished. It took just 10 days to retaliate but over 15 years to bring the perpetrators to justice.<sup>47</sup>

The US response on 14 April 1986 was called Operation *El Dorado Canyon*—a joint air attack on several sites in Libya using USAF F-111Fs and USN A-6s, A-7s and F/A-18s supported by KC-10 and KC-135 tankers. The Americans had been preparing for such an attack for over six months, with a long-range short notice practice mission from UK to Canada and back tasked in October 1985. The mission called *Ghost Rider* had shown the Libya raid was possible.<sup>48</sup> While the USN aircraft took off from aircraft carriers in the Gulf of Sirte, the F-111s took off from bases in the UK. Eighteen aircraft (plus six spares which returned after the first refuel) flew around Spain and France, across the Mediterranean, and on to their designated targets.<sup>49</sup> As well as tankers, four EF-111A electronic warfare aircraft were used to jam Libyan radars and their communications nodes. Nine F-111s attacked the Azziziyah Barracks in Tripoli, six attacked the airport, and three the terrorist training camps at Sidi Bilal. One F-111—the second last to attack—was lost and the crew presumed killed. Initially it was thought they had flown into the sea while approaching the target, it was later found that they had been hit by a surface-to-air missile .<sup>50</sup> The USAF quickly released cockpit video tapes of the raid, which clearly showed the precision attack on Colonel Gaddafi’s tent and the airport. Soon after, Reagan declared the raid a complete success.<sup>51</sup>

Table 6–2: Major ARDU F-111 Trials 1978–1988

Trial Number	Dates	Title
TI660	Feb 79	TFR Unsatisfactory Performance
TS1653	Feb 79 – Mar 80	Carriage and Release of Karinga
TS1646	Sep 79 – Mar 80	RF-111 Tropical Trials
TS1660	Apr 80 – Dec 80	TF30-P-3 Engine trials
TS1658	Oct 80 – Jan 81	OT&E on Cluster Bomb Stores (Karinga and CBU-58)
TS1650	Jan 81 – Jan 88	F-111C Instrumentation
TS1672	Mar 83 – Apr 87	Harpoon Clearance
TI894	Dec 84	MXU 648 Cargo Pod
TS1679	Mar 85 – Jun 87	GBU-15 Clearance
TS1667	Jan 86	F-111 Instrumentation
TI920	Dec 86	VHF-UHF Antenna Clearance
TI947	Jan–Mar 87	Cockpit Ergonomics Study
TS1668	Feb 87	F-111C Performance Maths Model
TI939	Mar–Apr 87	GBU-10 Clearance
TI967	Jun–Oct 87	F-111C Cockpit Rationalisation Assessment
TI943	Aug–Oct 87	AIM-9L/M Clearance
TS1691	Sep–Oct 87	Performance Maths Model (Nose Boom Transducer Unit)
TI974	Sep–Oct 87	Harpoon Captive Carriage Weapons Simulator (CCWS) Clearance
TS1692	Oct 87 – Jan 88	HARM Clearance



The raid and its immediate aftermath were announced in the Australian Parliament by Prime Minister Bob Hawke the next day.<sup>52</sup> While not involving Australia directly, the raid had two significant outcomes. First, it illustrated the value of the F-111 with *Pave Tack* and 2000-lb GBU-10 Paveway II Precision Guided Munitions under combat conditions—exactly the same capability that the RAAF had developed for its F-111Cs. While several USN Admirals later claimed the Navy could have done the raid by itself, the fact was they did not have the firepower, accuracy or penetration capability of the F-111s. Of all the weapon systems available to the US planners, they chose the one most suited to this kind of operation—the F-111.<sup>53</sup> Second, it was the longest ‘fighter’ combat mission in history which involved flight over 6400 nm (11 850 km), and required eight to twelve in-flight refuellings per aircraft. It reinforced the fact that nowhere on the globe was safe from air attack from land-based aircraft, and lessons learned were later applied during the 1991 Gulf War. The raid left a lasting impression in the US and gave planners much needed faith in the aircraft, so much so that during the 1989 Arms Reduction Talks, the US was loathe to destroy any of its F-111s as part of their agreed aircraft reduction deal.<sup>54</sup>

**Proving a Point – Crosshairs on the Window**

The second event that illustrated the value of the F-111 was home-grown. By 1985, the RAAF was arguing with Force Development and Analysis (FDA) Division in the Defence Central part of the Department of Defence in Canberra over retention of the F-111. FDA was located in the centre of power—‘F’ Block in the Russell Defence complex. Here, the senior staff of FDA appeared to the Air Staff as determined to retire the aircraft as soon as practical and recoup the attendant savings.<sup>55</sup> Seeing the F-111 as anachronistic, FDA continually opposed a fundamental update of the outdated analogue avionics systems to a digital configuration, claiming that it did not fit with strategic guidance and was

not cost-effective. FDA staff controlled the senior committee meeting agendas and minutes, and therefore generally controlled budget allocations and committee outcomes.

To convince the bureaucrats that the F-111 was still potent, in September 1987, an F-111 was tasked to fly down from Amberley one night and run a simulated *Pave Tack* precision strike on the office of the First Assistant Secretary who headed FDA. The resulting video tape showed the *Pave Tack* crosshairs accurately positioned on the office window and the audio counting down to ‘bombs gone.’ Wing Commander Peter Criss, who held the staff position of Operations Requirements – Strike Reconnaissance in Air Force Office at the time, recalled the incident:

I was trying very hard to progress the avionics update for the F-111. I was battling a brick wall with the First Assistant Secretary FDA and his staff and decided that I needed outside assistance. I called Amberley and made my request and told them the attack direction and which window I wanted hit. [CAS] Ray Funnell was going to a Force Structure Committee [meeting] and I went along as his sidekick and presented and explained the video. The Deputy Secretary and FASFDA were shocked but took it well and they asked for the tape to be played again, and they asked many questions. They could not believe the resolution. Ray [Funnell] was tickled pink with the way it all went. The only problem was that I told Amberley the window to hit was the first floor level, but whoever flew the mission went for the floor above. Even FASFDA admitted that he was dead regardless of which floor it hit.<sup>56</sup>

The sortie was labelled a ‘stunt’ by FDA staff. However, the stunt proved a point and was quickly picked up by the media, especially in Queensland.<sup>57</sup> The fallout was never quantified, but the episode must have left some impression as the F-111 survived further attempts in the 1980s to retire it as obsolete. More importantly, it was also a pronouncement that the F-111 was no longer just an ‘iron bomber’—a clear public demonstration of the F-111’s range and



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**Above**

Crosshairs on the window. A still from the cockpit video of the FDA ‘stunt’.

targeting accuracy. The incident was not be lost on other countries either.

**The 1986 Dibb Review and the 1987 Defence White Paper**

The decade 1983 to 1993 heralded the start of major changes to government policy regarding how the Defence Force was managed. It would be remembered as the start of commercialisation and a redefining of Australia’s strategic outlook. The F-111 played a major role in both activities, and how they were considered and implemented.

In February 1985, the Defence Minister, Kim Beazley, commissioned Paul Dibb of the Australian National University and a previous Deputy Secretary of the Defence Department, to undertake a review of Australia’s defence capabilities. It was the first major public review to be conducted since Vietnam and would usher in a new era in Defence planning. Dibb was not just to report on what he found, but ‘to make judgements on the appropriate balances between equipment, personnel numbers, facilities and operating costs, between current readiness and long-term investment, and between the relative priority

given to responding to various levels of possible threats.’<sup>58</sup> This review had the potential to lead to large changes in force structure, beyond the control of the Service Chiefs. In recalling the Government’s position, Kim Beazley stated:

Incorporated in Paul’s analysis was a high degree of scepticism about a strike option, and not only F-111s but also submarines. In my view (and Paul didn’t need much convincing), in order to have strategic weight in the region, you had to have the capacity to do people some damage ... I always thought the F-111s were a very valuable component of our air capability. So it did require a bit of discussion to ensure that it was incorporated into the White Paper.<sup>59</sup>

The Dibb Review, as it became known, was presented to Parliament by Beazley on 3 June 1986.<sup>60</sup> It generated considerable debate.<sup>61</sup> Dibb was thorough in his coverage of the terms of reference and, while the report began with the phrase: ‘Australia is one of the most secure countries in the world’, Dibb recognised that this would not always be the case.<sup>62</sup> Consequently, low-level conflict was seen as more credible, and as such, a layered defence strategy within Australia’s area of direct military interest was needed. It was a strategy of denial where the focus was clearly on what Dibb called ‘the sea and air gap’. As far as force structure determinants went, Dibb recognised eight important layers which should receive attention (in order of importance): intelligence and surveillance; long-range forces able to protect the sea-air gap including strike and interdiction; maritime defensive forces (air, surface and subsurface); and ground forces to clean up whatever enemy penetrated the first three layers.<sup>63</sup>

Needless to say, the Army was none too pleased with the outcome as, potentially, it meant resources being transferred to the Navy and Air Force at their expense, both in project and operational funding.<sup>64</sup> The RAAF senior leadership were happy as the question of the utility and longevity of the F-111 was partially settled, at least for the short term. If Dibb’s proposals were accepted, the F-111s would

be phased out at the end of the 1990s and the RAAF would acquire an additional 25 F/A-18s for maritime strike, together with air-to-air refuelling.<sup>65</sup> Other aspects of the RAAF Order of Battle were not changed. The F-111 had come under scrutiny earlier in the 1980s because of operating costs (quoted in the Dibb Report as \$72m per annum), and in the depths of the Cold War, their arguable deterrence value in Australia’s region of strategic interest was also considered doubtful. Dibb was open-minded about the role of the strike platform when he started his study, but after he visited the Amberley base and received briefings on the F-111’s capability, he made up his mind to keep it.<sup>66</sup>

Regarding guidance from Government or preconceived ideas about the F-111, Dibb later recalled:

The only ‘orders’ I had from Beazley was not to challenge the submarine decision. As an intelligence officer, I had no views about the F-111s before I did the Dibb Review. Two things influenced my thinking substantially: My first flight organised by CAS in an F-111 from Canberra in 1985 to Jindabyne-Thredbo valley and then out to sea and back to Canberra to beat up Russell Hill ... [and] the detailed briefings given to me by FDA about the costs of running the F-111 fleet compared with their undoubted strategic strike value.<sup>67</sup>

Despite any influence such a flight might have had, as to the F-111, Dibb’s Review recommended:

... *retention of the F-111 strike force with a minimum update program* designed to sustain the aircraft in service until about the mid-1990s, when decisions about their long-term future will be required. This force, together with the maritime-strike capacity of the Orion LRMP [long range maritime patrol] aircraft and the F/A-18 aircraft, comfortably meets our needs for strike aircraft. *Enhancement of the land-strike capacity of the F-111 force is not required at this time.*<sup>68</sup>

The emphasis was squarely on the maritime strike role. While acknowledging that the level of capability the aircraft provided was beyond what was needed in the mid-1980s, upgrading the fleet to maintain its viability seemed the most cost-effective option. Dibb estimated around \$470m would be required for the full upgrade proposed by the RAAF.<sup>69</sup> However, in his consideration, Dibb offered a further two options for the F-111 fleet: undertake a limited upgrade of around \$225m (Dibb’s preferred option), or dispose of the F-111 and acquire further F/A-18s for the strike reconnaissance role.<sup>70</sup>

One outcome not favourable for the RAAF was Dibb’s consideration of an air-to-air refuelling (AAR) capability. The RAAF wanted an AAR capability for both the F-111 and F/A-18 fleets, but while Dibb

**Below**

Dropping 12 x Mk 82 bombs at a Puckapunyal firepower demonstration day.

**Opposite**

The devastating effect.



Author



Author

agreed to the F/A-18 requirement, he saw no need to extend the F-111’s already ‘impressive’ range. This effectively killed off any F-111 AAR proposals, and led to a B-707 conversion package which only provided a training capability rather than one designed for lengthy operations.<sup>71</sup>

The Dibb Report marked a turning point in the development of Australian Defence and Strategic Policy. Gone was the concept of ‘forward defence’ within a series of alliances that had followed the decolonisation of South-East Asia. The Dibb Report ushered in the era of ‘self-reliance’ and the concept of ‘layered defence’ which formed the basis of the 1987 Defence White Paper, the first such document for over a decade. The concept of defending the ‘air-sea gap’ entered the defence lexicon and drove the debate for the next 10 years. However it was read, the Dibb Report was about the future defence force, not that of the time, so its focus was on ‘how

Australia should direct its spending priorities over the next decade [the 1990s] so that force structure more demonstrably reflects our unique requirements’ rather than attack the status quo.<sup>72</sup>

Dibb’s report was hailed by some and derided by others. It became the source of much debate between the military, academia and the defence media. Opposition Defence spokesman, Ian Sinclair, called the Dibb strategy, ‘a modern Maginot Line.’<sup>73</sup> It caused the recently retired CDFS, Air Chief Marshal Sir Neville McNamara, to put pen to paper in critique but, unfortunately, his 26-page rebuttal was never published.<sup>74</sup> McNamara argued that a strategy of ‘denial’ was too limiting and, in terms of strike, ‘there seems to be an underlying desire to restrict strike capability and keep it within certain bounds’. Furthermore, ‘the emphasis is on maritime strike and interdiction because it is less offensive in character and likely to be subject to fewer constraints



**AGM-88 HARM**

After a failure in the late 1960s to acquire the Martel AS 37, AGM-45 Shrike or Standard anti-radiation missiles for the RAAF under Air Staff Target (Guided Weapons) 13, in the 1970s, the Operational Requirements staff turned to the newer AGM-88 HARM or High-Speed Anti-Radiation Missile. Anti-radiation missiles are designed to lock onto enemy radar transmissions and then destroy them. They are particularly useful against enemy naval ships and surface-to-air missile sites to suppress their defences. On 22 October 1975, the Air Staff formally requested advice on HARM after an article appeared in *Aerospace Daily* describing the missile. Built by the Texas Instruments company, the HARM was designed to replace the Shrike and Standard ARMs of the decade prior, but with more advanced features. HARM would be an ideal complement to either Harpoon or LGBs in the strike role.

At 13.75 ft (4.2 m) and 800 lb (363 kg), the missile could be launched in one of three modes. ‘Target of Opportunity’ mode allowed the missile to find its own radar target based on pre-programmed threat data. ‘Self-Protect’ mode used data from the F-111’s radar warning receiver to detect and lock onto immediate, high threat emitters, while ‘Pre-Briefed’ mode was preset on the ground.<sup>75</sup>

HARM trials were approved for 1987–1988 at a cost of \$1.6m as Australia was the first to carry HARM on the F-111.<sup>76</sup> Four HARM missiles were acquired and ARDU was tasked to clear them for carriage and release. Supported by staff from the USN China Lake test facility, ARDU conducted carriage trials and fired the four inert missiles into the deep Southern Ocean under various test conditions to give a full flight envelope clearance.<sup>77</sup>



ARDU

A HARM missile leaves the rail at high speed.

than attacks on the enemy’s territory’.<sup>78</sup> While McNamara argued for the greater flexibility of air power, neither went so far as to raise the issue of power projection into and beyond the region, nor the matter of deterrence as a reason why countries such as Australia acquire a strike force in the first place.

Regardless, Dobb’s report became a blueprint for the 1987 Defence White Paper. Its title, *The Defence of Australia 1987*,<sup>79</sup> forewarned of its contents being heavily biased towards a self-reliant defence force that would focus on continental Australia. Beazley had announced as much when the Dobb Report was

**Air-to-Air Refuelling**

As well as a lack of guided weapons, the F-111s arrived without any air-to-air refuelling capability to further extend their strike range. While the aircraft were fitted with a refuelling receptacle on the fuselage behind the pilot’s head, this required a tanker aircraft to be fitted with an extendable refuelling probe called a ‘boom’—the standard USAF configuration. Complicating the matter, by the early 1980s, the RAAF had already decided to acquire the USN F/A-18 Hornet fighter to replace the Mirage, but these would be delivered with a completely different air-to-air refuelling system. The Hornet used its own aircraft probe and required any tanker to be fitted with a hose and drogue system, almost the reverse of the method used by the USAF. This was the standard USN configuration. Consequently, any air refueller bought by the RAAF had to be fitted with both systems to maximise air operations—an expensive and technically complex challenge.

After almost 10 years in service, during which time the F-111 avoided comment in Hansard and the media, in 1982, the operations of the F-111 were again raised. On the question of refuelling, the Government announced that ‘the present Service requirement for air refuelling aircraft is for an air-to-air refuelling capability using both the boom and drogue systems’.<sup>80</sup> The intent was to satisfy both the F-111 and F/A-18 requirements, but this naturally would incur additional cost.

Funding stalled and arguments continued, and in the end, only a hose and drogue system suitable for refuelling the F/A-18 Hornets was incorporated. Even this was to be a limited training capability as the Government announced in August 1986. Four B-707 transport aircraft were to be modified so that fuel could be drawn from their wings only and that meant they would be of little use for extended operations.<sup>81</sup> That decision effectively left the F-111 fleet out on its own when it came to operations over long distances. Many in the RAAF believed the Government had taken the soft option so as not to upset the region, even though the F-111s could already hit many regional targets. When accepting the F-111Gs, the Minister for Defence, Robert Ray, was again questioned about a refuelling capability for the aircraft. His reply was simple: ‘air refuelling was not needed, as the F-111 would be expected to land at “friendly” airfields enroute’. What these friendly airfields were was not specified.<sup>82</sup> Whether the decision was made for cost saving purposes or for Government policy reasons is not recorded, but it hampered RAAF operations and strike doctrine development as well as limited the weapons load. It effectively restricted the ADF’s ability to project power into South-East Asia and beyond.



RAAF Museum

A classic short of air refuelling under a KC-135 tanker.

**AIM-9L/M Air-to-Air Missile**

The lack of self-protection capability on the F-111 was first raised in the early 1970s as being a potential show stopper for the aircraft's offensive role, so the Air Staff seriously examined the option to acquire some form of self-defensive air-to-air missile.<sup>83</sup> Little came of this, but the Air Staff raised the issue again in the early 1980s. The RAAF was faced with a range of possible options—the US AIM-9 Sidewinder of which there were three potential variants, the French Matra R-550 Magic, the British ASRAAM and the Israeli Python. The AIM-9s on offer were the USN's AIM-9G/H, the USAF's AIM-9J or the new 'joint' AIM-9L/M series. Australia wisely chose the AIM-9L/M as it was proven in combat and was relatively easy to integrate.

The subsequent ARDU clearance of the AIM-9L/M Sidewinder air-to-air missile was conducted between August and October 1987, culminating in a live firing at Woomera.<sup>84</sup> While intended for self-defence, the carriage of the AIM-9 allowed the F-111 roles to be extended to include long-range intercept, a mission originally intended for the USN's F-111Bs. While not manoeuvrable enough to be considered as a fighter, the F-111 would have been more than capable of intercepting and destroying an enemy maritime patrol or transport aircraft at extended ranges from the mainland. The role of long-range air defence was thus added to the aircraft's secondary roles.



ARDU

The moment of launch – ARDU AIM-9 firing at Woomera.

tabled in Parliament.<sup>85</sup> It clearly echoed Labor Party policy, so it came as no surprise. Known as DOA87, the White Paper went further than Dibb, in that it foresaw three levels of potential conflict for Australia: low-level; escalated low-level; and more substantial conflict.<sup>86</sup> The question was: how would an F-111 strike force fit into this new paradigm?

DOA 87 recognised two elements of Australia's strike and interdiction forces: aircraft and submarines. It did not mention the Army's Special Forces under this mantle. Under the three levels of likely conflict theory, the F-111 force would be used for more substantial conflict only, and furthermore the paper argued that 'the introduction of the F/A-18 Hornet raises the possibility that Hornets could be used to replace F-111s lost from the strike force through attrition. A submarine-launched missile is another strike option for the longer term.'<sup>87</sup> As a guide for future force development, DOA 87 gave defence capability planners little to work with, but the demise of the F-111 strike reconnaissance force was not of immediate concern.

In fact, the position and utility of the F-111 force within the ADF's force structure was kept on both the political and the academic agendas. In 1989, Senator Gareth Evans, then Minister for Foreign Affairs and Trade, acknowledged that possession of a strategic strike capability was a 'major factor in Australia's ability to control the rate and level of escalation of hostilities: our strategy remains in the broader sense defensive, but does not preclude the use, as appropriate, of offensive tactics to achieve defensive goals.'<sup>88</sup> Further, in a groundbreaking Air Power Conference held in 1991, leading strategic analyst Des Ball of the Australian National University argued:

Conceptually, the most critical deficiency in Australia's strategic posture is the failure to develop adequate concepts for the *offensive* employment of the ADF beyond the air and sea gap. Australia's strategic posture is patently defensive. Nevertheless it

contains significant offensive elements, of which the most important is the F-111 force.<sup>89</sup>

In summing up the Government's position on the F-111 in the 1980s in retrospect, Kim Beazley stated categorically that:

The F-111 was simply regarded as a unique capability in the region. The Australian Labor Party never had a pacifist view. The people who opposed it tended to be from the left and be armed [but] neutral. There has always been the assumption that we operate in a somewhat threatening environment ...

We had to have a mix of strike capabilities ... Apart from being an annoyance, the F-111s were quite a reassurance. While no northern neighbour ever represented them to me as a threat, they probably would have thought that was a useless thing to do as I probably would have said, 'Oh good, glad you see them that way.'<sup>90</sup>

The concept of deterrence had finally come of age.

**The Avionics Update Program**

After the F-111 had survived the Dibb Review and the White Paper, the Air Staff looked to update the aircraft's obsolete avionic systems. Despite the addition of a precision targeting capability, by the mid-1980s, the F-111's analogue avionics, flight controls and weapons interfaces were increasingly unreliable and difficult to maintain. Manufacturers had ceased to make replacement parts and it became critical to update the aircraft or they would have to be retired within a few years. The USAF came to the same conclusion and was undertaking extensive upgrades to their FB-111A and F-111A/D/E/F fleets. Following the cancellation of the Rockwell B-1A bomber in June 1977 due to cost (estimated at US\$100m each), the Carter Administration looked at resurrecting the FB-111A fleet at least as a 'stop-gap' measure.<sup>91</sup> The FB-111s would be needed until the Advanced Manned Strike Aircraft could be procured, and that would take at least 10 years. This prompted an upgrade program.



Responding out of necessity, SAC immediately instituted an Avionics Modernisation Program (AMP) which was later adopted in most part by TAC which faced the same block obsolescence problem.<sup>92</sup> The F-111A/E AMP followed the FB-111A AMP but the software was different (due to different contractors) and as the Cold War was coming to an end, not all aircraft were eventually modified. After success with the AMP, the F-111Ds and Fs came due for upgrade and these were managed under the USAF's *Pacer Strike* program. Estimated at around US\$120m, *Pacer Strike* began in September 1989, and although the F-111D mod was cancelled in March 1990, upgrade of 29 of the 94 remaining F-111Fs continued. Although it was intended that the F-111 fleet would be life extended until 2010, all were retired by July 1996, but the work done on the *Pacer Strike* program would benefit the RAAF.

Before the USAF's success with both AMP and *Pacer Strike*, the RAAF Air Staff began to consider similar update programs for the F-111C. The idea was formally raised in March 1978, and the RAAF sought and received USAF approval to participate in their F-111A/E Nav/Bomb system digital update study, to commence in July.<sup>93</sup> To remain engaged, the RAAF raised 'Project Air 83 – F-111C Aircraft Avionics Systems Update' and wisely decided to phase it. Phase 1, a feasibility study, was completed in 1979 and, as well as examining the digitisation option, also considered incorporation of a range of modern stand-off weapons including the HARM, GBU-15 and Maverick air-to-ground missile.

As the decade progressed, Project Air 83 became Project Air 5225 and the Operational Requirements – Strike Reconnaissance staff in Air Force Headquarters developed a position paper to examine the range of options for the F-111 fleet.<sup>94</sup> The issue of an 'overdue' F-111 upgrade had been raised in Parliament by the Liberal Opposition in 1987, prompting further Government consideration.<sup>95</sup> While Minister for Defence Beazley had announced 'more than \$200m' would be spent as part of the 1988 Defence Budget, media speculation and a close

reading of the budget papers noted the estimated cost was upward of A\$240m, but all agreed something had to be done.<sup>96</sup> The argument used in 1988 was not one of improving system accuracy, but of cost saving by increasing reliability and maintainability of the various systems. Precision would be a valuable side effect, but at the time, was not seen as politically astute to be argued. The AUP would increase the Mean Time Between Failure (MTBF) of the avionics, navigation and weapons equipment from about 3.5 hours to 19.5 hours, a major advantage for operational planners and maintenance and logistics personnel.<sup>97</sup> The paper developed by the staff offered five broad options:

- mothball the fleet and develop a replacement proposal;
- do nothing and continue to use spare/used analogue parts from the US;
- purchase up to 20 Tomahawk cruise missiles for the RAN's Frigates and the proposed Collins Class submarine fleet to replace the F-111s in the strike role;
- purchase more F/A-18s and the associated weapons for the strike role, or
- upgrade the F-111Cs with digital avionics and flight controls.

The paper was presented to the Force Structure Policy and Planning Committee in 1989. The RAAF wanted to update the aircraft and argued it was in keeping with 1987 Defence White Paper direction. The Navy preferred the cruise missile option for obvious reasons.<sup>98</sup> The Army questioned the cost of all bar option two. However, no-one wanted more F/A-18s. The RAAF argued that an AUP provided the best value for money and also would extend the life of the F-111 fleet by another 20 years (at that time assessed as 2010), thereby obviating the need for a new aircraft for at least another decade. Chief of the Air Staff, Air Marshal Funnell, argued that cruise missiles might be considered a deterrent, but what would Australia do for strategic strike once the 20 missiles had been fired?<sup>99</sup> Lost flexibility by having

limited assets assigned to surface vessels that could not be transferred at sea, or rapidly repositioned, further supported the argument for an airborne capability. The only realistic option was an AUP. The reason was simple: analogue parts were becoming scarce and extremely expensive to purchase and maintain. The capability development staff also noted that digital avionics would save weight and space, and were more reliable, thus saving hundreds of maintenance man hours. For the operators, this would result in a greater number of aircraft on line.<sup>100</sup>

The Committee recommended option five on the basis of reliability and maintainability, and the Government agreed.<sup>101</sup> Once a Request for Proposal (RFP) was released, two industry consortia vied

for what was expected to be a US\$250–\$350m contract. General Dynamics teamed with Aerospace Technologies of Australia and British Aerospace Australia; while Rockwell International teamed with Hawker de Havilland Australia to bid for the contract. The third contender, Grumman Aerospace, pulled out.<sup>102</sup> After an exhaustive evaluation process, Rockwell eventually won the US\$389m contract which was signed on 17 August 1990, and the winner was announced six days later.<sup>103</sup>

The AUP entailed several key components. These included a new digital flight control system, dual digital mission computers, a new stores management system and two ring-laser gyro inertial navigation systems aided by GPS. New displays and secure radios would further upgrade the cockpit. Separate contracts for A\$68m were let with Texas Instruments for updated TFR sets, and with General Electric for a new attack radar system.<sup>104</sup> As well as install the AUP equipment, the opportunity to fit improved

**Below**

F-111 AUP transitioned to Amberley. Here Rockwell workers strip out the cockpit.



RAAF Museum



electronic warfare equipment was also taken while the aircraft were stripped down. The Australian AUP would benefit from advances in digital avionics, allowing a much larger weapons computer to be included in the work than the type fitted to the US aircraft. After inclusion of the additional elements, the program was scoped at A\$400m (US\$320m), which would be split 50:50 between the US and Australian industry, but costs finally came in at A\$474m.<sup>105</sup>

The work commenced with stripping the entire cockpit (less the throttles and control columns)

**Below**

AUP Flight Test Team, Jul 1993.  
John Daley, Gary St Clair, Phil Pluis, Ron Tester, Cam Morris, Michael Dickson, Keith Schaumberg, Mal Hurman, Scott Goyne, Ms Lori Parsons, Mick Devlin, Mark Skidmore, Trevor McCormack, Chris Miller, Neil Stains, Shane Rochford, Rod Smith, Greg Hume, Pieter Deboer

and the removal of aircraft panels and wiring harnesses. The analogue components were then replaced with the digital systems. Extensive ground testing commenced in February 1994 at the USAF's Palmdale facility in California, and the AUP aircraft was finally rolled out for its first flight on 2 December 1994.<sup>106</sup> It then underwent four months of functional test flights at Palmdale, followed by 12 months of performance, weapons and system evaluation trials out of McClellan AFB and into the China Lake instrumented range.<sup>107</sup> F-111C A8-132 eventually returned to Amberley on 9 June 1996. The remaining 20 RF/F-111C aircraft were upgraded at Amberley. The first locally modified aircraft (A8-142) was rolled out to much ceremony on 13 December 1995 and made its first flight on 27 February 1996.

The remaining work was initially undertaken by Rockwell Australia through their subcontractor, Hawker de Havilland of Victoria, but after Boeing acquired Rockwell in 1996, Boeing Australia became

prime contractor for the AUP project. By late 1999, the Boeing workforce had grown to 90 personnel working on the modification, and another 75 on the Weapons System Support Facility. Illustrating how the industry had matured over the life of the project, the final AUP modified aircraft (A8-148) was rolled out of the Boeing hangar 410 at Amberley on 17 November 1999.<sup>108</sup> The ceremony marked not only the completion of the AUP, but also the commissioning of the new flight simulator and, importantly, the start of a long and successful collaboration between the RAAF and Boeing. During the acceptance speech, the Chief of Air Force, Air Marshal Errol McCormack, stated that the MTBF had been demonstrated to be 179 hours, nine times more than originally anticipated—a success for both partners. McCormack might also have added that with AUP, *Pave Tack* and modern stand-off weapons, the F-111 could now find, fix and finish off virtually any target of its choosing.

However, 'Project Air 5225 – Avionics Update Program' was not a stand-alone program. In order for the F-111 fleet to remain viable until after the turn of the century, notionally to 2010, 'Project 5208 – Replacement Simulator' and 'Project 5136 – Automatic Test Equipment for the F-111' had also been raised in the early to mid-1980s.

**The Replacement Simulator**

The first F-111C Simulator was bought as part of the original package in 1963 and delivered in 1969, but it was based upon FB-111A flight dynamic data and F-111A engine performance data, so it never fully represented the Australian aircraft. By 1980, the original simulator had become just a procedural emergencies trainer, and was being used mainly for crew proficiency testing and emergency checklist response. Although a partial upgrade was considered when *Pave Tack* was incorporated into the aircraft, it was not considered economically viable to do so. Only the navigator's radar scope (the Virtual Image Display or VID) was replaced in the late 1980s, but there was no *Pave Tack* functionality. The arrival

of the AUP again gave the RAAF the opportunity to either upgrade the existing simulator to AUP configuration, or acquire a complete replacement.

By the late 1980s, simulator technology had improved immensely. Available were highly dynamic visual systems, higher fidelity aeronautical performance models and significant computing power to drive the simulator in near real-time. Simulators had become almost as realistic as the aircraft, but without the expense and safety issues associated with real-world flying. The problem was, so good was simulator technology, that the aircrew saw them as a direct threat. According to project engineer, Squadron Leader Geoff Northam:

The pilots, of course, saw simulators as a threat to the number of aircraft hours that were being flown and I think about 4700 hours a year were being flown. The Department wanted some sort of trade-off ... that was not a particularly popular concept amongst the aircrew who felt at the time they were pretty close to their limit of what they could sustain [to keep current].<sup>109</sup>

A deal was eventually struck at 4400 hours as part of the approval, and \$45m allocated for the project under Project Air 5208. The funding would include simulator, training package, facility works and maintenance.

A three-man RAAF team was sent off to the US and UK in 1990 to examine both new and used simulator options.<sup>110</sup> These included used FB-111A simulators from Pease AFB, used F-111F simulators from RAF Lakenheath, a new simulator from the Link company at Binghamton, NY, parts of a used Tornado simulator, and a new simulator from Rediffusion in the UK. After extensive review, the most cost-effective option was to modify an F-111F simulator for RAAF use, so when the 48th Tactical Fighter Wing at Lakenheath returned to Cannon AFB in New Mexico, their simulator became available. It was purchased by the RAAF to be supplied as Government Furnished Equipment (GFE) as a shell,



Chris Miller



**Automatic Test Equipment**

While the Automatic Test Equipment (ATE) might not seem important, it was vital if the RAAF and Australian industry wanted to be able to support the F-111 fleet through to life of type. The original ATE was acquired in the early 1970s and was built around a number of test stations driven by a central computer called a CENPAC (Central Processor and Comparator). It was extremely limited by modern standards, but a single set of stations was designed to support a USAF squadron of 24 aircraft. The RAAF in its wisdom purchased two sets—one intended for No 482 Squadron and the other for deployments. In the later years of their life, the RAAF could keep at least one station working at any one time, and thus keep aircraft in the air. The RAAF was moving into a completely new era of complex digital avionics systems.

As a follow-up to the AUP, the ATE also needed updating, so Harris Government Systems of Florida were contracted to deliver two sets under a \$45m-contract and Squadron Leader Len Neist, with a small support team, was appointed to oversee the work.<sup>111</sup> The Harris intermediate level ATE consisted of three test stations and was designed to test and fault-find the avionics equipment, saving time and money. The equipment would be operated as a team effort between the RAAF, under the officer-in-charge, Flight Lieutenant Terry O'Brien and Harris Total Contractor Support, under manager, Mr Mark Garman.

**Weapons System Support Facility**

To be developed as part of the package, the RAAF also specified a new kind of facility to support the advanced technology, and the software in particular, that the AUP provided. The Weapons System Support Facility (WSSF) delivered an in-country capability which not only allowed software changes and updates to be made faster, but save millions in US contractor costs. The WSSF consisted of a Systems Engineering Laboratory (SEL), which provided the capability to develop operational flight program changes in simulated in-flight conditions. The WSSF was opened in April 1995 and consisted of an F-111C crew module, a forward equipment bay, software development stations, various computer systems and a simulation interface unit.

The WSSF soon paid dividends. It was used for a range of development activities from minor changes of the AUP displays to major integration work, such as the Block Upgrade Program (discussed in Chapter 7), and the incorporation of new digital weapons into the aircraft's inventory. Once Boeing were contracted to support the F-111 fleet, the company took over the facility until the WSSF was decommissioned in 2009. The WSSF concept was therefore the first step toward self-reliance in the complex world of aircraft software maintenance and development, and set the standard for future aircraft system acquisition.

for further modification to AUP standard by the winning contractor.

Four companies tendered for the project. Link, the original simulator manufacturer; CAE; Honeywell; and Wormald Australia who teamed with US company SBS. Subsequently, on 31 August 1993, a A\$19m contract was signed with Wormald Australia.<sup>112</sup> The selection of Wormald came as a surprise to many, as the company was known mostly as a fire and security systems provider. Wormald was later acquired by Thomson-CSF Pacific who had a long record of accomplishment with defence products. As part of the contract, the RAAF supplied the F-111F Simulator module and associated equipment, and a comprehensive mathematical performance model which had been developed by DSTO Air Operations Division and ARDU.

The Wormald solution replaced about 80 per cent of the existing simulator, and nearly all the work was done in Australia. It was rated as the option with the highest risk, but the RAAF argued that Wormald had the most to lose if they did not deliver. Problems

soon arose. Wormald did not have a tight contract with their partner, SBS in the US, and the original \$2.5m subcontract to supply simulation expertise quickly turned into \$8m and forced a considerable delay in development while the problem was sorted. Wormald found an alternative source of expertise, Mike Renie from SBS, and hired him. Despite the early difficulties, the new simulator went on to be a great success and remained in service with the RAAF until the aircraft were withdrawn in December 2010. According to the project officer, Wing Commander Brian Walsh, the experience taught Wormald 'how to work with the big boys', meaning the large US Defense contractors. For the RAAF, it was an education for future contracts.

The F-111C Simulator was handed over and officially opened at RAAF Amberley on 17 November 1999, with Thomson-CSF under contract to the Commonwealth for both operation and maintenance of the facility.<sup>113</sup> The new simulator had been configured for both *Pave Tack* and AUP and, unlike its predecessor, it had no motion system but had visuals. As well as the crew module, the simulator

comprised an instructor console, a projection display unit, specialised computers and a test station. Most importantly, the land mass used in the visual scenes and radar/*Pave Tack* displays was Australian, and included RAAF airfields, Australian terrain and a variety of representative targets. The RAAF turned to a reserve officer, Squadron Leader Steve Clarke, to run the simulator and, eventually, Clarke joined the Thales company to manage the simulator under contract after Thales replaced Thompson-CSF. It was a win-win as the RAAF got a fully qualified and experienced F-111 pilot who had also been a navigator, and Thales did not have to recruit and train up a specialist.

The simulator was far superior to that delivered with the original aircraft delivery and became an important training tool for crew development, proficiency monitoring and categorisation. Such was its utility that in April 2004, an upgrade to the visual displays was approved which would see the simulator through to end of F-111 life.<sup>114</sup>

**The First Gulf War – 1991**

If any reinforcement was needed of the value of the F-111 in modern air warfare, it came with the 1991 Gulf War. Operation *Desert Shield* preceded Operation *Desert Storm* and it was during this early phase that Australia considered sending aircraft, including F-111s, to bolster the USAF resources. In particular, the USAF realised their tactical reconnaissance capability was limited after giving much of their reconnaissance work to intelligence agencies and placing their sensors into space. Space systems did their job, but their 1980s technology could not penetrate cloud, dust or smoke, making them useless for near real-time battle damage assessment, and urgent requests for information from those in the field. The USAF made a formal request for RAAF RF-111s but, after consideration of risk, the Hawke Government chose to send ships, a medical team and mine clearance divers.<sup>115</sup> Kim Beazley was no longer the Minister for Defence, but he put the view that Australia should have sent the RF-111s to the Gulf 'for bomb damage assessment', but was overridden by his Labor Party colleagues.<sup>116</sup>

The subsequent Operation *Damask* was mostly a naval affair. According to Air Chief Marshal Sir Neville McNamara, this was a direct result of the acquisition philosophy that the Department applied to many projects in the 1980s, especially those with a weapons or electronic warfare (EW) focus:

The main outlook within the Public Service side of the Department was ‘don’t let us commit ourselves too much’ ... the thrust of the Department was let us go with ‘fitted for but not with’ ... with the result that when real action occurred, particularly with the Americans, we couldn’t go because while we might have had some of the fitment, we didn’t have all the fitment, and we certainly didn’t have the compatible weapons.<sup>117</sup>

McNamara had retired in 1984, so was perhaps unaware of just how capable the F-111s were. According to Air Vice-Marshal Peter Criss:

The F-111C with *Pave Tack* and GBU-10/12 was precisely what the USAF had and I know that from personal dialogue with their chief planner, General Buster Glosson. We had been wired for the ALQ-131 ECM pod and the USAF offered to ‘loan’ us those pods and [software] programs ... I am not sure how well Air Force Headquarters and Air Command understood our real capability ... the ignorance level was high within both HQs as to what the upgraded ‘pig’ could do.<sup>118</sup>

Meanwhile, the USAF had previously adopted some of the Australian techniques. Criss continued:

I know from personal discussion with high ranking USAF officers that it was a USAF WSO who had returned from a tour with No 1 Squadron who convinced his commanders to try what he learnt in Australia and so ‘tank plinking’ came about. The concept of Precision Air Support (PAS) and *Pave Tack* Recce preceded the Gulf War by two years.<sup>119</sup>

Although the Australian F-111s did not deploy, the RAAF’s F-111 Gulf War did not end there. F-111s worked up the RAN fleet as it sailed and gave the

Navy much needed practice at air defence. By operating out of East Sale, Edinburgh, Pearce and Cocos Islands, the aircraft continued exercising the RAN ships well out into the Indian Ocean, providing valuable air attack training for the Australian Naval Task Force as it went off to war.

Meanwhile, the USAF deployed 66 F-111s of the 48th Tactical Fighter Wing to Incirlik, Turkey, to prosecute strike operations over Iraq. The concept of operations initially was coordinated low-level strikes at night, delivering precision guided munitions by six aircraft against well-defended pinpoint targets. By the end of the first night, and after no losses, this changed to much larger formations, culminating in up to 24 aircraft conducting airfield attacks as the war continued. While the details of the USAF success with the F-111 is beyond the scope of this chapter, the relatively small force is credited with 920 Iraqi tank kills (called ‘tank plinking’). Only the F-111s carried the 5000-lb GBU-28 ‘bunker busters’ to destroy Saddam’s underground facilities, and when the Iraqis set fire to the Kuwaiti oil fields, only the F-111s carried the GBU-15 needed to extinguish them.<sup>120</sup>

More importantly for the RAAF, the USAF F-111 experience again validated the RAAF’s faith in its PGM acquisitions, *Pave Tack* and the planned avionics upgrade. F-111Fs with *Pave Tack* dropped the full range of laser-guided bombs without losing a single aircraft during the entire 43-day war. As the post operations analysis began, it became clear that the F-111s with *Pave Tack* flew more missions and destroyed more targets than any other aircraft type in the war, remarkable since the aircraft flew just five per cent of the total sorties.<sup>121</sup> So successful were the F-111s, that the USAF Official History of the Gulf War, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, chose to depict a *Pave Tack* equipped F-111F on its cover ahead of F-15s, F-16s, F-117s, B-52s and a suite of other more modern and more photogenic options.<sup>122</sup>

Operation *Desert Storm* was important for RAAF air planners because it became a template for air operations in the 1990s and beyond, and began the transition to thinking about how best to use the aircraft given that experience. The RAAF pushed to get avionics, weapons and EW upgrades for its F-111, F/A-18 and P-3 fleets; and the concept of the Air Tasking Order, the planning cycle and the targeting methodology were all adopted by Australia, making it relatively easy to integrate Australian air combat forces with those of the US in the 2003 Iraq War and beyond.

**Development of an Indigenous EW Capability**

The main reason the RAAF’s F-111s did not go to the Gulf was their lack of self-protection, as they were only ‘fitted for, but not with’ modern electronic warfare equipment. This was the next major improvement required by the F-111 force. The Gulf War deployment rebuff came at a time when the RAAF was in the early stages of developing its own electronic warfare capability that was not beholden to the data provided by others, particularly the United States. In the early 1990s, the F-111 thus became the test case for the RAAF’s Electronic Warfare Squadron at Edinburgh. The squadron’s first challenge was to develop the software for and reprogram the F-111’s old Radar Warning Receiver (RWR) with a contemporary software threat library, as the extant system only had Soviet-era data that was no longer relevant to the Australian region.

Electronic Warfare Squadron had to have the new software installed and working for Exercise *Pitch Black* ’93. Group Captain Dave Dunlop who was Officer Commanding No 82 Wing, found that the path for formal RAAF clearance to use the new software was just too tortuous. He conferred with Wing Commander Julie Hammer, the Commanding Officer of Electronic Warfare Squadron, and as the modification did not interface with any other aircraft system, they made the decision to load the modified program before *Pitch Black*. Dunlop later recalled the outcome:

That program was the big test for EW Squadron. When we put it in and flew it against the F/A-18s, I went out to meet the crew on the flight line at Darwin and their hands were going everywhere and I thought, ‘I think this has been successful’ ... The next day, the F-18 guy at EW Squadron copped a phone call from the Operations Officer at 75 Squadron asking: ‘What @#\$! have you done to those @#\$! F-111s?’ That’s when we knew it was successful.

The experience was a first for the RAAF and meant that Australia now had a nascent EW programming capability upon which to build.

**EW Upgrades and Project *Echidna***

Approximately 20 per cent of the F-111’s avionics systems relate to managing the electromagnetic spectrum. The equipment is designed for self-protection and is both active (it transmits or radiates) and passive (it receives). Such electronic warfare systems are therefore classed into two categories: Electronic Support Measures (ESM) and Electronic Countermeasures (ECM). ESM equipment comprises a Radar Warning Receiver (RWR) used for detecting hostile radars, and an Infra-Red Detection System (for approaching missile warning). The ECM equipment includes chaff and flare dispensers and jammers.<sup>123</sup>

The first experience Australian F-111 crews had of offensive and defensive electronic warfare was in the airspace above Hawaii at exercise *RIMPAC 75*. This major US exercise involved air and naval forces from Canada, New Zealand, the US and Australia, with over 200 aircraft and 31 major naval vessels.<sup>124</sup> According to Squadron Leader Alan Lockett who participated: ‘it was our first experience of a “high density” electronic warfare environment’ and, while no F-111s were claimed to have been ‘shot down,’ crews soon realised that the electronic warfare aspect of their business was becoming highly significant.<sup>125</sup> EW system upgrades would have to occur regularly if the F-111 strike force was to survive in modern air combat. To get around problems with EW



equipment, the early F-111 concept of operations was to penetrate below enemy radar, attack the target and egress rapidly before the air defences could react. That still required forewarning of all enemy air defence systems, so by the late 1970s, the original 1960s analogue technology was obsolete, as it only had Vietnam-era threats programmed into it.

Consequently, between 1981 and 1983, a Radar Homing and Warning System (RHAWS) upgrade—Project Air 62—was instituted. The \$16m upgrade to the F-111’s RWR delivered a digital replacement which was a vast improvement on its predecessor. This equipment had rapid response, detected a wider frequency range of threat emitters and was programmable. However, as with all electronic processors, it too became obsolete within 10 years.<sup>126</sup> At the same time as the RHAWS was being upgraded, so too were improvements to the ECM sets warranted. The RAAF sought to meet the EW needs of both the F-111 fleet and the New Tactical Fighter Project (which would become the F/A-18) by acquiring ECM pods under Project Air 75. Six of the pods were destined for the F-111 fleet, but the pods were never acquired, so improvements to the ECM system had to be made later under Project *Echidna*.

Project *Echidna* was the name applied to a combination of electronic warfare enhancement projects (Projects Air 5391, 5394 and 5416) which sought to both update equipment and achieve commonality across a number of aircraft types. The F-111 was a major beneficiary, but it was a long and drawn-out process. After much delay, Project *Echidna* was finally approved in December 1993. The intention was to fit an indigenous suite, comprising a radar warning receiver (called the ALR-2002), a towed radar decoy (developed by DSTO), and a missile approach warning receiver in the aircraft’s tail.<sup>127</sup> A new chaff and flare dispenser would also be acquired separately under Project Air 5391. These would all be incorporated into the F-111 fleet during the Block Upgrade Program (BUP) and are discussed in the next chapter.

**Further Defence Reviews**

While the 1970s has been referred to by retired Chief of Army, General Peter Leahy, as the years of ‘coming home’ and the 1980s as ‘the years of introspection’, he termed the 1990s as the decade of ‘coming out’—out to Somalia, Rwanda, Cambodia, and various other UN deployments, and finally, to East Timor.<sup>128</sup> Under DO A87, expeditionary operations were anathema, the very term excised from strategic planning documents and speeches given by senior military officers. Much emphasis was placed upon Australia’s responsibilities regarding the US security commitment to the region, but by the late 1980s, few in Washington had ever heard of Nixon’s Guam Doctrine, let alone knew what it said. The 1987 Defence White Paper, DOA 87, did not predict the end of the Cold War, but it did foresee a changing regional dynamic—the days of the known balance of East-West power were gone. It ushered in a further series of Defence reviews as planners grappled with the new world disorder.

The first of a series of reviews appeared between 1989 and 1991 and fundamentally changed the way support services were delivered to the Defence Force.<sup>129</sup> While each review had its own impact, all squeezed more out of a shrinking Defence budget at a time when strategic uncertainty became the key concern. The most influential documents were *Australia’s Strategic Planning in the 1990s* (ASP 90) and *Force Structure Review 1991*. The former, which was written in 1989 with a public version released in 1992, provided the strategic guidance necessary for the DOA 87 force structure process. The latter document set the ADF on a course of commercialisation and contracting out of ‘support’ functions and followed directly from the Wrigley Review of two years prior. The Force Structure Review, in particular, had a significant effect on the F-111 strike reconnaissance capability as maintenance and logistic support that had previously been preserved in-house as a matter of policy was now up for contracting. It was Paul Dibb who drafted *Force Structure Review 1991* and who recalled:

The [strategic strike value of the F-111] was confirmed very positively when I was managing the drafting of the Force Structure Review in 1991 as Deputy Secretary and Navy and Army were plotting to get rid of them [the F-111s]. I got FASFDA to brief the augmented COSC and the F-111s were saved.<sup>130</sup>

The Force Structure Review was commissioned by the Minister for Defence, Senator Robert Ray. Ray was a Labor Party powerbroker and the right person to drive efficiencies within the largest Government Department. Among the Force Structure Review outcomes was a greater reliance on Reserves (particularly for Army) and contractors, the expansion of the Five Year Defence Plan (FYDP)—essentially the budget—into a Ten Year Defence Plan (TYDP), and a move to the north and west of the country, allegedly to be closer to any threat axis that might emerge in the nearer term. While the F-111 fleet did not get much attention, acquisition of small stocks of stand-off weapons and, as importantly, a reduction in the number of Permanent Air Force crews by three with substitution by up to 12 Reserve crews was proposed.<sup>131</sup> The practicality of flying currency and availability of these Reserve personnel clearly was not considered.

The release of *Force Structure Review 1991* followed an extensive review in 1989 by Alan Wrigley, a former Deputy Secretary of the Department of Defence. His groundbreaking *The Defence Force and the Community: A Partnership in Australia’s Defence* recommended greater use of civil infrastructure and industry to undertake support activities, and greater use of the Reserves.<sup>132</sup> The Interdepartmental Committee (IDC) that followed Wrigley recommended the introduction of a Commercial Support Program to conduct various maintenance, logistics and base support functions. The program allowed for market testing of various tiers of activities, with the RAAF able to submit in-house bids. Not surprisingly, very few of the in-house bids won against commercial interests. The previously exempt F-111 fleet was no longer preserved, so on the one hand the F-111 aircraft would be upgraded

and retained till 2010, on the other, the supporting tail would be rationalised and contracted out. Clearly a huge challenge lay ahead.

The release of ASP 90 meant that force structure planners had to think first and foremost in terms of how capability could be used for the defence of the island continent, rather than continue with the equipment replacement mentality of the past. It was a first step to the development of a much tighter process, where capability decisions had to satisfy a range of criteria, not just fill the equipment gap in a Service-perceived void. ASP 90 also reprioritised the principal defence role, with intelligence collection and evaluation given first priority. Strategic strike was placed well down the order, coming after surveillance, patrol and response.<sup>133</sup>

The combined outcome of ASP 90, the Force Structure Review and the IDC on the Wrigley Review was the Commercial Support Program (CSP). CSP forced a major change onto Defence as it challenged the entire organisation to become more efficient. Being effective was another matter. CSP ushered in a wide range of commercialisation opportunities for base support, maintenance and the various Defence logistics units, as well forcing a restructure in Defence acquisition. Industry was able to compete against in-house proposals for a range of Defence activities. The program completely changed the way the RAAF undertook F-111 maintenance and this had implications for the future.

Later reviews further reshaped the Defence environment. *Strategic Review 1993* released in December that year was part of the new cycle of planning activities, prompted by the end of the Cold War and the emerging doctrine of how the Keating Government saw Australia’s place in the world. ‘Defence in depth’ emerged with few differences from the layered defence proposed by Dibb, and the only ‘new’ idea was a regional security community in South-East Asia. Strategic strike was almost begrudgingly reaffirmed as:

... this option might be exercised to dissuade an adversary from using military force against us, to force the adversary to cease hostilities, to raise the costs to the adversary, to control escalation or move the focus of operations, or to force the adversary to undertake extensive defensive measures.<sup>134</sup>

*Strategic Review 1993* used the language of deterrence and specifically chose to define the term ‘strategic strike’ as ‘offensive action conducted against an adversary’s assets or capabilities not otherwise in contact with, or directly threatening, our own forces or interests.’<sup>135</sup> The statement appeared to have been included almost as if to justify retention of the strike capability while placating Australia’s northern neighbours. Not all the pundits saw the value of *Strategic Review 1993*, and even Alan Wrigley put pen to paper to criticise the document.<sup>136</sup> Curiously, the newspaper’s editor chose to use a single photo to illustrate Wrigley’s diatribe—an F-111 taking off with the caption: ‘Lack of Direction: an RAAF F-111 ... defence is on an irrelevant course.’

**Below**  
A8-143 undergoes maintenance.



RAAF Museum

Nevertheless, *Strategic Review 1993* formed the basis of the third Defence White Paper, *Defending Australia* 1994 (DA 94), which again argued the need for strike forces (F-111s and submarines) and the need to keep them up to date. In a way, the policy from 1991–1994 was behind the developments that had already been applied to the F-111 fleet, but there was little else to offer the readership. The Government could not identify a replacement to the aircraft that was less ‘offensive’ nor could it cancel the role as this would have been unacceptable to the electorate. Australians still wanted a bomber and the F-111 fitted the role nicely.

**The Restructure of Maintenance and Logistics Support**

Until the mid-1980s, engineers were grouped at Support Command by specialist role. The area responsible for the F-111 was known as AIRENG. AIRENG1D, for example, was the staff officer responsible for F-111 aircraft maintenance, and drew together all the specialists needed to maintain the fleet under a matrix management system. By 1983, after a major reorganisation project by retired Air Commodore Ron Hargreaves created the Logistics

Division under the Controller of Logistics, the RAAF internally reorganised Support Command to form Support Groups (SGs) for the equipment personnel.<sup>137</sup> SG7 was created to support the F-111 fleet, but although engineering staff were not included, a natural synergy existed between SG7 and AIRENG1D. The two areas found they needed to work together and thus the idea of a weapons system management process began to emerge. The F-111 program led the way. In 1986, as well as amalgamating engineering into logistics functions to form a new Logistics Command, the RAAF merged the F-111 logistics elements into Strike Reconnaissance Logistics Management Squadron and relocated it to Amberley.

Although an adequate airworthiness process was now in place, unfortunately, the RAAF Engineering Branch was disbanded as one outcome of the Government’s 1992 Commercial Support Program. Gone with the Branch was the appointed technical airworthiness authority and, to quote the Air Officer Commanding Logistics Command at the time, ‘RAAF engineering management is in trouble.’<sup>138</sup> Consequently, the RAAF had to repair the damage done by overzealous policy implementation and the response had to be implemented quickly. In 1993, Air Commodore John Macnaughtan and a small team of staff officers produced *Blueprint 2020*, a report on the future of RAAF engineering and engineering management. *Blueprint 2020* was a response not only to the Force Structure Review and the Commercial Support Program mandated changes, but also to the lack of a whole-of-life support plan required of such a complex weapons system as the F-111.<sup>139</sup>

For the F-111 fleet, the institution of an Air Worthiness Board was therefore timely. While the F-111 accident rate had been low, fatigue and serviceability problems were arising because of the ageing fleet, and logistics support was becoming more difficult to deliver. A desal and reseal of the fuel tanks was required because the tanks were leaking, and engine combustion chamber cracking and wing fatigue life were other deep concerns.

Although the aircraft had been ‘g’ limited to preserve their structural integrity, there were still concerns over fatigue life and the growing cost of maintaining airworthiness. As the RAAF underwent a series of rapid changes to the support side of its business, the establishment of the Air Worthiness Board process enabled a smoother transition to full commercial support.

**Amalgamation of Maintenance Units**

After the Government released *Force Structure Review 1991* and CSP, the in-house maintenance units at Amberley came under intense scrutiny. Operating costs, personnel expenses and the logistics tail were targeted. Forgotten was the original decision in 1972 to keep maintenance of the F-111 in-house.

While successive Governments had paid lip service to suggestions of commercialisation, none had set up a formal program to institute it, but under Defence Minister Kim Beazley that changed in 1991. While the Wrigley Review went so far, the Hawke Government tasked an Interdepartmental Committee (IDC) to examine and recommend an implementation strategy. The IDC recommended, *inter alia*, widespread commercial opportunities be examined and that ‘activities currently undertaken by the military could be more effectively and efficiently performed by industry or civilians.’<sup>140</sup> The era of Defence ‘Civilianisation’ had begun. The IDC pronounced that ‘civilians are approximately 20–25% cheaper than military personnel’ and that the use of contractors would produce additional cost savings through ‘improvements to work organisation, practices and productivity’.<sup>141</sup> No data was provided to justify these assertions, but arguments by senior military staff against the approach were ignored.<sup>142</sup>

The IDC specifically highlighted that F-111 maintenance other than squadron or operational level maintenance could be done by contractors.<sup>143</sup> This was true, so F-111 intermediate level (at No 482 Squadron) and depot level (at No 3 Aircraft Depot) maintenance and engine overhaul facilities were



listed as Tier 1 commercialisation activities, with tenders to be called ‘progressively, but no later than the end of 1992.’<sup>144</sup>

The RAAF took the first step in December 1991 by amalgamating its maintenance units. The idea arose as a recommendation from ‘RAAF 2000 – Our Flight Plan for the Future’, a medium term plan directed by the Chief of the Air Staff, Air Marshal Ray Funnell. On 16 March 1992, No 482 Maintenance Squadron officially amalgamated with No 3 Aircraft Depot to form No 501 Wing.<sup>145</sup> No 501 Wing absorbed Strike Reconnaissance Logistics Management Squadron, so also gained logistics management responsibilities, at a time when CSP was pushing for the contracting out of much of the Wing’s work. Group Captain Chris Tyler, the Officer Commanding, found he was establishing a massive new unit, trying to contract out functions while submitting in-house options, and bringing a new aircraft, the F-111G, into service at the same time. It was a stressful time for everyone.

With 1240 personnel, No 501 Wing was the largest in the RAAF. At the same time, support elements from Headquarters Logistics Command in Melbourne relocated to Amberley and formed the Strike and Reconnaissance Logistics Management Unit or SRLMU. A number of maintenance personnel were posted to the operational squadrons, as senior staff sought to preserve at least some maintenance capability for deployed operations.

The effect on the RAAF was dramatic. It gave the operational squadrons a sharper focus, and the morale of the maintenance personnel at the operational squadrons skyrocketed. For once, they had a unit identity and a distinct esprit de corps developed. For those left in No 501 Wing, morale plummeted while they awaited the inevitable commercialisation axe to fall. However, the Wing, now comprising two technical maintenance squadrons and a logistics support squadron, set about producing in-house bids to win back the maintenance and support work. To the surprise of many, the Wing’s innovative bid won the follow-on

F-111 maintenance work, with resulting savings in the first year of \$9m.<sup>146</sup> However satisfied the unit may have been about winning the work back, the days of RAAF in-house maintenance on the F-111 were numbered.

Notes

1 OAFH, CAS Weekly Conference Minutes, 9 May and 11 July 1977.

2 ‘Replacement F-111s’, in *RAAF News*, vol. 22, no. 7, August 1980.

3 OAFH, CAS Conference 25/81, 23 November 1981.

4 In May 2007, AMARC was renamed the 309th Aerospace Maintenance and Regeneration Group (AMARG).

5 ‘First two of new F-111s’, in *RAAF News*, vol. 24, no. 5, June 1982. The aircraft flown as ‘A’ models pending upgrade were A8-109, 112, 113 and 114.

6 OAFH, CAS Conference 18/81 Minutes, 29 June 1981.

7 The *Pave Spike* system was an electro-optical laser designator pod used to guide LGBs onto a target. A crew member using a TV image projected from the pod could place crosshairs on the desired impact point.

8 ‘Pave Tack operational on European F-111s’, in *Flight International*, 9 January 1982, p. 78.

9 ‘Backgrounder: system aims at boosting strike accuracy’, in *RAAF News*, vol. 22, no. 9, August 1980.

10 ‘Pave Tack Target System Demonstrated’, in *Aviation Week & Space Technology*, 6 September 1982, p. 200.

11 Wing Commander R.W. Howe, ‘What Australia Needs is a Good Revolution the PGM Revolution’, in *Australian Defence Force Journal*, April 1978, pp. 7–18; and R.W. Howe, ‘Pave Tack – Standard Weaponry for the F-111?’, in *Pacific Defence Reporter*, April 1980, pp. 18–24.

12 Sub-systems included the AN/AAQ-9 forward looking infra-red (FLIR) system, the AN/AVQ-25 laser range finder/target designator and a virtual cockpit display. Michael J. Gething (ed.), *Jane’s Electro-Optic Systems 2007–2008*, 13th edition, Jane’s Information Group, Coulsdon, 2007, p. 525.

13 Wing Commander Alan Lockett, interview, 1 April 2010 and correspondence.

14 Wing Commander Lance Halvorson, interview, 22 October 2009.

15 Group Captain Bennett, interview, 12 April 2010.

16 The General Dynamics *Pave Tack* Project Team consisted of Flight Lieutenant John Monaghan (Project Manager); Flight Sergeant Peter Boyd; Corporals Wayne Biles, P.J. Bruce and Charlie Gray, and Leading Aircraftman Peter Weier. ‘Pave Tack Team’, in *RAAF News*, vol. 26, no. 1, January-February 1984, p. 1.

17 Group Captain Greg Fitzgerald, correspondence. The flight test crew were Flight Lieutenants Tim Jones and Greg Fitzgerald. The secondary crew were Squadron Leaders Frank Atkins and Al Curr.

18 Flight Lieutenant Lindsay Passfield, ‘Spotlight on Pave Tack Section, 3AD’, in *RAAF News*, vol. 27, no. 9, October 1985, p. 11.

19 ‘Rapier accuracy for F111C’, in *RAAF News*, vol. 27, no. 9, October 1985, p. 1. A8-147 had actually flown a shakedown test flight on 9 September 1985.

20 After the USAF retired its *Pave Tack*-equipped F-111Fs in the mid-1985s, additional pods became available. The four RF-111Cs were not upgraded.

21 Air Vice-Marshal Dunlop, interview, 9 October 2009.

22 Group Captain Bob Downing, interview, 11 December 2009.

23 Stephens, *Going Solo*, p. 392.

24 Group Captain Downing, interview, December 2009. Downing was on the *Pave Tack* project and was the AUP project manager.

25 Air Chief Marshal Sir Neville McNamara, interview, 20 April 2009; Wing Commander Halvorson, interview, 22 October 2009.

26 Air Vice-Marshal Rogers, interview, 6 May 2009.

27 The toss bomb manoeuvre required the aircraft to run in to the target, pull up and roll onto its back, and toss the bombs to the target as it pulled. This increased the aircraft’s distance from the target, thus reducing its exposure to anti-aircraft weapons.

28 NAA: A7941, F14; and COSC Minute 73/1971, 24 November 1971.

29 Ronald T. Pretty, in *Jane’s Weapons Systems 1986-87*, Jane’s Publishing Co, London, 1986, p. 191.

30 Wing Commander Bob Howe, discussions with author.

31 The nuclear weapons panel was left over from the F-111A design but had no utility in the RAAF F-111Cs and the RAAF was tasked with conventional weapons delivery only. Group Captain Downing, interview, 11 December 2009.

32 Wing Commander Halvorson, interview, 22 October 2009.

33 ‘Simply Superb’, in *RAAF News*, vol. 26, no. 7, August 1984, p. 1. The crew was Squadron Leader Pete Salvair (Pilot) and Flight Lieutenant Charlie Colgan (nav). Salvair, correspondence, 28 September 2009.

34 ARDU, file 2535/3/1672 Tech (3).

35 The author was the flight trials navigator for TS1672. Author’s Flying Log Book.

36 Group Captain Fitzgerald, correspondence. The carriage trials began on 28 March 1985. This was very tight as the last ARDU BATV release was on 26 March 1985.

37 ‘A \$1 million hit’, in *RAAF News*, October 1988, p. 13; and Air Vice-Marshal Dunlop, interview, 2 September 2009. The crew were Wing Commander Dave Dunlop and Squadron Leader Pete Layton.

38 ‘Drug freighter meets spectacular end’, in *The Sydney Morning Herald*, 23 March 2006.

39 Wing Commander Wills, interview, 14 December 2009.

40 Weapons data collection summaries 1967–1977, courtesy Wing Commander Bob Howe.

41 Wing Commander Wills, interview, 14 December 2009.

42 ‘Pave Tack operational on European F-111s,’ *Flight International*, 9 January 1982, p. 78.

43 ‘RAAF tests GBU-15,’ in *Flight International*, 2 November 1985, p. 9; and Group Captain Fitzgerald, correspondence. The flight test crew were Flight Lieutenant Tim Jones and Squadron Leader Greg Fitzgerald.

44 OAFH, Air Vice-Marshal Collins, Oral History Program interview, November 2007.

45 *ibid.*

46 Group Captain R.V. Richardson, ‘ARDU’s role in support of RAAF aircraft airworthiness,’ in *Flying Safety Spotlight*, Issue No. 2/87, Directorate of Air Force Safety, Canberra, 1987, p. 3.

47 While the US had intercepted messages between Tripoli and Libyan agents in Europe, it was only after the collapse of the Soviet Union and the opening of the East German Stasi files that proof was obtained of direct Libyan Embassy involvement and thus official Libyan Government sanction. Four terrorists were subsequently tried and jailed in November 2001. See Natalie Malinarich, ‘Flashback: The Berlin Disco Bombing,’ in *BBC News Online*, 13 November 2001. See <http://news.bbc.co.uk/1/hi/world/Europe/1653848.stm>, accessed 30 May 2009.

48 Warren Thompson, ‘Mission Ghost Rider 1985,’ in *Air Forces Monthly*, May 2010, pp. 92–97.

49 The attack was claimed as a right of self-defence by the US under Article 51 of the UN Charter.

50 Thompson, ‘Mission Ghost Rider 1985,’ p. 95.

51 Don Logan, *General Dynamics F-111 Aardvark*, Schiffer Military History, Atglen, PA, 1998, p. 286; Victor Flintham, *Air Wars and Aircraft: A Detailed Record of Air Combat, 1945 to the Present*, Facts on File, New York, NY, 1990, pp. 90–92; and Gary Klott, ‘Ramifications of Libya Raid,’ in *New York Times*, 16 April 1986, p. D 8.

52 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 148, 15 April 1986, p. 2269.

53 Walter J. Boyne, ‘El Dorado Canyon,’ in *Air Force Magazine*, vol. 82, no. 3, March 1999, pp. 59–60.

54 Air Vice-Marshal Tony Mason, *Air Power: A Centennial Appraisal*, Brassey’s, London, 1994, p. 126.

55 Air Vice-Marshal Peter Criss, correspondence.

56 *ibid.*

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59 Beazley, interview, 25 June 2009.

60 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 149, 3 June 1986, p. 4419.

61 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 150, 21 August 1986, pp. 423–426.

62 *The Dibb Report*, p. 1.

63 *The Dibb Report*, pp. 6–10.

64 ‘Defend the North: Our new strategy,’ in *The Sydney Morning Herald*, 4 June 1986, p. 1; ‘Forces chief faces defence gap,’ in *The Age*, 4 June 1986, p. 1; and ‘Dibb: defend the north,’ in *The Canberra Times*, 4 June 1986, p. 1.

65 ‘Hornets to take over as F-111 phased out,’ in *The Sydney Morning Herald*, 4 June, 1986, p. 4; and ‘Maintain F-111s, and 25 more F-18s will do the job,’ in *The Age*, 4 June 1986, p. 17.

66 Beazley, interview, 25 June 2009; and Paul Dibb, interview, 21 December 2009 and correspondence. Also discussions with Air Vice-Marshal David Dunlop (who was Commander Strike Reconnaissance Group at the time).

67 Professor Paul Dibb, correspondence, 21 December 2009.

68 *The Dibb Report*, p. 7.

69 This included: AUP – \$219m; ATE – \$91m; Simulator – \$41m; PGM – \$62m; and EW upgrades – \$60m. *The Dibb Report*, p. 121, footnote 9. A further \$152m was proposed for PGM reserves beyond the FYDP.

70 *The Dibb Report*, p. 121.

71 *ibid.*, p. 9. In 2002, the B-707 tankers were used over Afghanistan, but they had to be based close to the area of operations.

72 *ibid.*, p. 176.

73 ‘The Dibb Report: Recognition of air power,’ in *RAAF News*, vol. 28, no. 6, July 1986, p. 6; and *The Age*, 4 June 1986, p. 1.

74 Air Chief Marshal Sir Neville McNamara, ‘A Critique of the Dibb Report,’ unpublished paper. Copy provided to the author by Sir Neville.

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78 *ibid.*, p. 16.

79 *The Defence of Australia 1987*, Australian Government Publishing Service, Canberra, 1987 (referred to as DOA 87).

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82 Air Commodore John Kentish, interview, 29 April 2010.

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84 Author’s Flying Log Book entries. The author conducted these trials with (then) Flight Lieutenant Mark Skidmore, RAAF F-111 test pilot.

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89 Professor Desmond Ball, ‘Air Power in the Regional Balance: Maintaining the Peace in South East Asia,’ in Alan Stephens (ed.), *Smaller but Larger: Conventional Air Power into the 21st Century*, RAAF Air Power Studies Centre, Fairbairn, 1991, p. 41.

90 Kim Beazley, interview, 25 June 2009.

91 Wayne Wachsmuth, *B-1 Lancer*, Tab Books, Airlife, Shrewsbury, 1990, p. 9.

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93 OAFH, CAS Weekly Conference Minutes, 14 March 1978.

94 Developed by Wing Commander John Kennedy (ORSRECON), the author (who was ORSRECON1) and Neil Orme (Force Development and Analysis Division).

95 Commonwealth of Australia, *Parliamentary Debates – House of Representatives*, vol. 156, October 1987, p. 10598.

96 ‘F111s Into 21st Century,’ in *RAAF News*, vol. 30, no. 8, October 1988, p. 1; Mike Gaines, ‘Australia’s F-111 update debate,’ in *Flight International*, 14 January 1989, p. 19; and ‘Marlow,’ ‘Progressive modernisation of the F111 is vital,’ in *Pacific Defence Reporter*, March 1989, pp. 17–18. Project manager Bob Downing recalled the AUP was costed at \$160m with a project allocation of \$389m. Group Captain Downing, interview, 11 December 2009 and correspondence.

97 Mean Time Between Failure (or MTBF) is an engineering term used to specify the average expected operating time of a piece of equipment before it requires servicing. A low MTBF means shorter usage and more servicing. The higher the MTBF the better, and the lower the cost of ownership.

98 The Tomahawk option continued to surface for another decade. It was debunked as completely unrealistic in Carlo Kopp, ‘Tomahawks, Submarines and the F-111,’ in *Australian Aviation*, January/February 1996, pp. 42–45.

99 The point was moot, as the USN was not prepared to sell the technology to a foreign customer in the Asia-Pacific. The issue was one of targeting and strike intelligence, neither of which was releasable to Australia at the time.

100 Neil Orme, discussions.

101 ‘F111 avionics to be updated,’ in *RAAF News*, vol. 31, no. 2, March 1989, p. 3.

102 General Dynamics had won the AMP contract and Rockwell the *Pacer Strike*. Rockwell’s Australian subsidiary was Rockwell Electronics Australia, which later became Boeing Australia.

103 Group Captain Downing, interview, 11 December 2009.

104 For a complete technical description of the AUP see Carlo Kopp, ‘New Tusks for the Pig,’ Parts 1–3, in *Australian Aviation*, June, August and September 1995. The AN/APQ-128 TFRs were replaced by AN/APQ-171B TFRs, the AN/APQ-165 ARS were upgraded to AN/APQ-169 status. KY-58 secure voice HF and *Have Quick II* UHF frequency agile radios were added. David Baker, *Jane’s Aircraft Upgrades 1999–2000*, Jane’s Information Group, Coulsdon, 1999, p. 7.

105 Baker, *Jane’s Aircraft Upgrades 1999–2000*, p. 417.

106 Flown by RAAF test pilot Flight Lieutenant Cam Morris and project navigator Flight Lieutenant Chris Miller on 2 December 1994. ‘Testing time for F-111s,’ in *RAAF News*, June 1994, p. 1; ‘First F-111 upgrades expected mid-year,’ in *RAAF News*, January/February 1995, pp. 1 and 11; and Miller, interview, 16 November 2009.

107 ‘Prototype AUP F-111 to start flight tests in USA soon,’ in *Australian Defence Report*, vol. 5, no. 13, 21 July 1994, p. 6.

108 ‘F/RF-111 Avionics Update Program comes to end,’ in *Australian Defence Report*, vol. 10, no. 23, 9 December 1999, p. 16; and Scott Mason, ‘F-111s Set for the Future,’ in *Australian Aviation*, January/February 2000, p. 85.

109 Wing Commander Northam, interview.

110 The team consisted of Wing Commander Bob Howard, Squadron Leader Geoff Northam and the author, then a Squadron Leader.

111 *RAAF News*, August 1992, p. 10. The team consisted of Squadron Leader Len Neist, Flight Lieutenant Bill King, Warrant Officer Jim Cooper, Flight Sergeant Steve Dickenson, Sergeant Mark Smith, Corporal Kari Partanen and Ms Georgette Schommer.

112 ‘F-111 sim. Upgrade begins,’ in *RAAF News*, October 1993, p. 3; and ‘Upgraded simulator slowly taking shape,’ in *RAAF News*, June 1994, p. 11.

113 ‘Thomson-CSF develops F-111C Mission Simulator,’ in *Australian Defence Report*, 9 December 1999, p. 17.



- 114 Daniel Cotterill, 'Visual Upgrade for F-111 Simulator', in *Australian Defence Magazine*, May 2004, p. 36.
- 115 Greg Sheridan and Nicholas Rothwell, 'Canberra plan to send ships to the Gulf', in *The Australian*, 10 August 1990, p. 1; Greg Sheridan and Roy Eccleston, 'Evans considers role in possible air blockade', in *The Australian*, 18 September 1990, p. 1; Peter Hansen, 'Aussie planes set for strike flight into Iraq', in *The Courier Mail*, 11 November 1990, p. 6; and 'F-111s stay in Australia says Scott', in *The Queensland Times*, 16 January 199, p. 2.
- 116 Beazley, interview, 25 June 2009.
- 117 Air Chief Marshal Sir Neville McNamara, interview, 20 April 2009.
- 118 Air Vice-Marshal Criss, correspondence.
- 119 *ibid.*
- 120 For complete details, see 'Operation Desert Storm: Evaluation of the Air Campaign', United States General Accounting Office, Washington, DC, June 1997, p. 28; and Alfred Price, 'Deadly Darkness', in *Flight International*, 10–16 July 1991, pp. 33–35.
- 121 Sixty-six F-111E/Fs and 18 EF-111As were deployed. Boyne, 'El Dorado Canyon', p. 60; Logan, *General Dynamics F-111 Aardvark*, p. 287; Major James E. Rotramel, 'Replacing' the F-111', in *Air Force Magazine*, October 1995, p. 6; and Gary Waters, *Gulf Lesson One – The Value of Air Power: Doctrinal Lessons for Australia*, RAAF Air Power Studies Centre, Canberra, 1992, p. 208.
- 122 Richard G. Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, Air Force History and Museums Program, Washington, DC, 2002.
- 123 ECM equipment comprises an IR detector in the tail which is used in conjunction with the Countermeasures Receiver System (CMRS) to warn of a hostile missile approaching. The crew can then use the Countermeasures Dispenser System (CMDS) to release flares or chaff to decoy the missile, or use the ECM transmitter to jam its homing signal. The Radar Homing and Warning System (RHAWS) detects hostile radar signals and display these threats to the crew on a scope in the cockpit. The full capability of the F-111s EW systems remains classified and, regardless, is too complex to be covered in this book. Individuals wishing to learn more about these early systems in general are referred to C.G. Heath, 'F-111 electronic warfare systems', in *Pacific Defence Reporter*, August 1981, pp. 47–52.
- 124 'Rimpac 75 Involved Four Nations', in *RAAF News*, April 1975, p. 3.
- 125 Wing Commander Lockett, interview, 1 April 2010.
- 126 Heath, 'F-111 electronic warfare systems', p. 52; and '\$16m boost for F-111s', in *RAAF News*, vol. 22, no. 7, August 1980.
- 127 'ALR-2002 near full production', in *Australian Defence Magazine*, October 2005.
- 128 Lieutenant General Peter Leahy, 'Australia's National Security', address to the United Services Institute of the Australian Capital Territory, 4 March 2009, at <http://www.rusiaust.org.au/presentations>, accessed 8 April 2009.
- 129 These reviews/reports included: *Review of Australia's Defence Facilities: Report to the Minister for Defence by Robert J. Cooksey*, known as the Cooksey Review, 1988; *The Defence Force and the Community: A Partnership in Australia's Defence*, known as the Wrigley Review, 1990; *The Report on the Structural Review of Higher ADF Staff Arrangements*, known as the Sanderson Review, 1989; Defence Logistics Redevelopment Project (DRLP), 1990; Defence Regional Support Review (DRSR), 1990; *Report of the Interdepartmental Committee (IDC) on the Wrigley Review*, 1991; and *Force Structure Review 1991*.
- 130 Dibb, correspondence.
- 131 *Force Structure Review 1991*, Australian Government Publishing Service, Canberra, 1991, pp. 27–28.
- 132 Alan K. Wrigley, *The Defence Force and the Community: A Partnership in Australia's Defence*, Australian Government Publishing Service, Canberra, 1990, p. 477. The report was known colloquially as the Wrigley Review.
- 133 *Australia's Strategic Planning in the 1990s*, Department of Defence, Canberra, 1992, p. 29.
- 134 *Strategic Review 1993*, Department of Defence, Canberra, 1993, p. 65.
- 135 *ibid.*, footnote 9, p. 65.
- 136 Alan Wrigley, 'Defence strategists locked in the past', in *The Australian*, 28 February 1994, p. 9. Wrigley was Deputy Secretary of the Defence Department from 1982 to 1985.
- 137 Air Vice-Marshal Ian Sutherland, correspondence.
- 138 *Blueprint 2020: Engineering the Future*, Defence Publications, Canberra, July 1993, p. 2-1.
- 139 Air Commodore John Macnaughtan, correspondence.
- 140 *Report of the Interdepartmental Committee (IDC) on the Wrigley Review*, as tabled by the Minister for Defence, May 1991, Australian Government Publishing Service, Canberra, 1991, p. 4.
- 141 *ibid.*, p. 7.
- 142 Air Vice-Marshal Ian Sutherland, interview, 28 October 2009 and correspondence. Air Vice-Marshal Sutherland complained that the basis for cost comparisons was deeply flawed. One example cited was costs of training. Training for RAAF maintenance workers was included, but not for their civilian equivalents.
- 143 *Report of the Interdepartmental Committee (IDC) on the Wrigley Review*, p. 15.
- 144 *ibid.*, p. 37.
- 145 '501 Wing rises like a phoenix', in *RAAF News*, February 1992, p. 10.
- 146 '501 Wing', in *Defence Update No 8*, Defence PR, Canberra, undated, p. 18.

# 7. SUSTAINMENT

## 1993–2010

*The decision to retire the F-111s early cannot have been easy and would certainly not have been taken lightly ... it may prove to be a strategically sound move in the long run.*

Daniel Cotterill<sup>1</sup>

With the aircraft upgraded and precision weapons on order, the RAAF F-111C was again considered one of the most effective strike and reconnaissance aircraft in the world. By the mid-1990s, the reconnaissance capability suffered from obsolescence as it was not upgraded, and over the sustainment period, the strike capability was gradually run down. A surprise government decision to acquire an additional 15 F-111Gs from ex-USAF stock added to fleet management stress. The first part of the sustainment period would therefore present new problems for the RAAF. The most serious was the deseal/reseal program for fuel tank maintenance, which left a lasting and unfortunate legacy for many maintenance workers. The second was a new role for the aircraft called Precision Air Support. Finally, as well as managing commercialisation of the workforce, the RAAF became sole operator after the USAF retired the last of its F-111s in 1998.

By the mid-2000s, the F-111 was at its peak of capability. It had been fully upgraded, had advanced weapons in inventory and was assured of remaining in service till the end of the decade. The RAAF had transitioned to industry maintenance and had overcome numerous difficulties presented in the prior decades. The aircraft's apparent longevity led to much debate about keeping it in service beyond its 2010 expiry date. Proponents of such a strategy argued the F-111 had to be kept as the 'silver bullet' and a new, advanced stealth fighter, such as

the F-22 Raptor, be acquired to maintain regional air superiority. Such was not to be as the RAAF favoured the multi-role Joint Strike Fighter (JSF) as a replacement for both the F-111 and F/A-18s. This chapter concludes the study of the F-111 with an assessment of its utility and its deterrence value.

### **The F-111G Acquisition**

A close cousin of the F-111C was the FB-111A model developed for the US Strategic Air Command (SAC), the American nuclear bomber force. The FB-111s had the same longer wings and heavier undercarriage as the RAAF's F-111s, but there were differences. The FB-111s were fitted with the so-called Triple Plow II intakes (see Chapter 3), up-rated engines, and Mark IIB avionics, including an astro-tracker for navigation. They also carried different shaped pylons, designed for nuclear stores. Once SAC received the larger B-1B *Lancer* bomber in June 1985, 34 FB-111As were transferred to the Tactical Air Command (TAC) and switched to the tactical role. The FB-111s were not fitted with *Pave Tack* and had a different mission computer, so were somewhat orphaned from their more capable F-111C cousins.

Redesignated the F-111G for TAC, the aircraft had the nuclear weapons equipment and the astro-tracker navigation system removed, and new navigation and radar systems fitted under the Avionics Modernisation Program mentioned previously. The F-111Gs entered TAC service from



1989, but with the end of the Cold War and with operating costs rising, they became surplus from mid-1991 and were grounded.<sup>2</sup>

Plans to retire the USAF F-111Gs as part of the Clinton Administration military forces drawdown coincided with the Australian Government considering its options to extend the life of the F-111C fleet beyond 2010. While attention initially focused on refurbished A-models as had been acquired in 1982, the F-111G option suddenly appeared a sound choice. The G-models were younger, had more advanced avionics (much like the AUP), and already had longer wings and heavier undercarriage. Lastly, they had up-rated engines that provided greater thrust.

Without warning, on 15 October 1992, the Defence Minister, Robert Ray, announced the acquisition of ‘up to 18 F-111G aircraft at a cost of A\$72m,’ surprising everyone including Senator Gareth Evans, the Foreign Minister, who was pushing a more peaceful regional policy.<sup>3</sup> Ray declared he had a meeting with US Defense Department officials, and that they strongly approved of the idea. In his announcement before the Senate, Ray stated that ‘the Government’s action will ensure that we retain superior strike and interdiction capability in our sea-air gap’ and further, that there would be ‘no further upgrades of the F-111 strike capability beyond the current capability.’<sup>4</sup> This time, the media were more accepting of the buy.<sup>5</sup>

The initiative was Prime Minister Paul Keating’s idea, and only he, Senator Ray and Finance Minister Ralph Willis were aware of the proposal. Former Defence Minister Kim Beazley recalled:

The young Paul Keating was fascinated by technology. I remember sitting in his office one time when he was a young MP [Member of Parliament] and he hauled out diagrams of the F-111. [He stated that] ‘This is the most beautiful aircraft’ and he went through the dynamics of the swing-wing and the components of it. And we just chatted about it ... the upshot of all of that was when he was Prime Minister, he became

alerted to the fact that there were a bunch of cheap F-111s going and he absolutely insisted we buy them. So that was a Keating decision.<sup>6</sup>

The first the RAAF knew was when Senator Ray called the Chief of the Air Staff, Air Marshal Ray Funnell, over to Parliament to inform him.<sup>7</sup> Funnell was astounded when Prime Minister Keating announced he wanted to buy 52 F-111Gs. Funnell recalled: ‘my immediate thoughts were that the RAAF couldn’t handle such a number and, more importantly, what would the neighbours say?’<sup>8</sup> The 52 aircraft were quickly negotiated down to 36. Air Commodore Errol McCormack, who was Director General Force Development (Air), found he had to quickly make the arrangements. McCormack recalled that the news ‘took everyone by surprise, especially me as I was supposed to organise such projects! The initial direction was to acquire 36



Defence PR

**Above**  
Prime Minister Paul Keating was a huge fan.

**Opposite**  
Minister for Defence Robert Ray who announced the F-111G deal..



Defence PR

aircraft but, fortunately, I managed to get that down to 18.’<sup>9</sup> Eventually, Australia acquired 15 F-111Gs (the other three were held for Australia by the USAF) and 12 spare engines under the hastily organised Project 5404. The purchase would allow the allocated F-111 flying hours to be spread over a larger fleet, thereby extending the aircraft’s service life.<sup>10</sup> Eight of these aircraft were brought up to RAAF airworthiness standard, five were placed in storage and two were destined to be stripped for spare parts. Given the apparent fleet life extension, the planned withdrawal date of the F-111G was also set at 2020 like the F-111Cs, then a further 25 years.

In an ironic twist, Opposition Defence spokesman, Alexander Downer, was due to announce the Liberal’s defence policy a week after Ray’s statement, and he complained that the F-111G purchase was a political stunt to steal his limelight. However viewed, it was the same tactic Menzies used in October 1963 when he originally announced the purchase of the F-111 to effectively silence his opposition. However,

the timing of the announcement had little to do with the Liberal policy launch, but was more about US politics within the Bush (Senior) Administration. US presidential elections were due to be held at the end of 1992, and although the F-111Gs would be available after that time, they would not necessarily remain so under a Democrat President if one was elected. This combined with Prime Minister Keating’s fascination with the aircraft and their bargain basement price, meant the decision had to be made quickly.<sup>11</sup>

Others were equally against the purchase. Former Departmental Deputy Secretary, Alan Wrigley, later wrote scathingly to *The Canberra Times* that the F-111 was ‘a white elephant good only for the knackery’ and that the decision to buy F-111Gs and extend the F-111 life to 2020 was ‘questionable’. He rightly noted that the aircraft were already 30 years old and, consequently, any work on them, in his mind, would be a waste of money. Carrying on his own personal crusade, he challenged Senator Ray’s reasoning to buy more F-111s to defend the ‘air-sea gap’ saying the F/A-18s and P-3Cs with Harpoon could do as much. Erroneously, he stated that ‘the swing-wing design was never very relevant to Australia’s needs since if the F-111 was to carry a useful load of non-nuclear weapons under its wings, they could not be swung back.’<sup>12</sup> Wrigley’s criticism was ignored.

The Government paid the A\$70m for the airframes, plus another A\$74m for parts and logistics support, but the RAAF had to find operating and maintenance costs from within its own budget. It was a difficult budgetary issue that was not easy to solve. The funds were eventually found and the RAAF later retrofitted digital flight controls, so at around \$10m apiece, the aircraft were still a bargain. Although there was also some thought of doing an AUP ‘upgrade’ under a Capability Optimisation Program, the idea was eventually abandoned as too costly for the expected return.<sup>13</sup>

Before acceptance, two crews and a number of maintenance personnel were sent over to Cannon

AFB to train on the G-models, although the similarities between the types made this relatively easy.<sup>14</sup> The aircraft were returned to full flying status by the Sacramento Air Logistics Center before being ferried across the Pacific in pairs without tanker support at monthly intervals. Despite the excellent reputation the F-111s had developed over the previous 20 years, the media still sought to grab attention with headlines like ‘Why do we need more old bombers?’, but their point was well made.<sup>15</sup>

The introduction into service was managed by Squadron Leader Bill Lawrence with a small team from what was then the Defence Acquisition Organisation. Wing Commander Jeff Walsh and Squadron Leader Rob Black did a sterling job liaising with the USAF and managing the aircraft’s return to Australia. The \$70m had to be spent by 30 June the following year, making a very tight schedule. Nobody in Defence believed it could be done, but it was.<sup>16</sup> One F-111G aircraft, nicknamed ‘The Boneyard Wrangler’, was taken from the Aircraft Maintenance and Regeneration Center (AMARC), the aircraft graveyard at Davis-Monthan AFB, Arizona. It was the only F-111 ever to return to flying condition from AMARC and is now located at the RAAF Museum, Point Cook. The remaining 14 came directly from Cannon AFB. The first two arrived in Australia on 28 September 1993 and the remainder were flown in during the first half of 1994.

Painted in low visibility ‘Gunship Grey’ paintwork, the aircraft were officially accepted by Defence Minister Ray on 11 October 1993. Standing on the dais in front of the first two ‘new’ acquisitions, Ray pronounced: ‘The purchase of these aircraft sits well with Australia’s policy of defence self-reliance and will realise significant long term benefits for Australia’s security.’<sup>17</sup> It marked an interesting change from previous Labor Party policy of two decades prior.

Once in Australia, the question arose of what to do with the F-111Gs. The aircraft only had a limited number of flying hours remaining; there was no

money for maintenance, and no guidance on how they were to be used. One concept was to park them at the Woomera airfield, but the direction from Air Force Headquarters was that they were to be flown. That meant development of a flight manual, and working out what the aircraft could do. After Air Commodore Pete Growder arrived as Commander Strike Reconnaissance Group in December 1997, the decision was made to use them for training, exercises, air shows and other public events.

Only one F-111G was lost in RAAF service. Sadly, Squadron Leader Anthony ‘Shorty’ Short and Squadron Leader Stephen ‘Nige’ Hobbs were killed flying A8-291 on the night of 18 April 1999. During a simulated night maritime strike attack, their aircraft struck trees on an 1100-ft ridge on Aur Island in the South China Sea, just off Malaysia’s east coast. The aircraft was destroyed on impact. The crew was leading a flight of two F-111G aircraft as part of an Integrated Air Defence System exercise, under the auspices of the FPDA.<sup>18</sup> The accident left everybody in shock and, on completion of the accident inquiry, led to significant changes to risk management procedures ADF wide. Shortly after the Board of Inquiry findings, the ADF introduced a formal risk management process for all air operations, and established crew resource management courses specifically tailored for F-111 operations.

The Australian F-111Gs operated for 14 years before their early retirement. On 6 March 2007, Minister for Defence, Brendan Nelson, announced the Government had decided to acquire a fleet of 24 F/A-18E/F Block II Super Hornets as a stopgap measure until the F-35 Joint Strike Fighter (JSF) was in service. The JSF would replace all the F-111s and F/A-18s from about 2015. Following this announcement, the F-111G fleet was officially retired with the last flight on 3 September 2007. Apart from ‘The Boneyard Wrangler’, all the remaining F-111Gs are intended for disposal; however, because of US International Traffic in Arms Regulations (ITARs), they will be cut up for scrap.<sup>19</sup>

Table 7–1: RAAF F-111G Data

Aircraft Type	RAAF Serial Number	GD Block No & USAF Serial No	First Flight	Delivery/ Acceptance	Arrival in Aust.
F-111G	-	B1-7 / 67-7193	-	-	-
F-111G	-	B1-8 / 67-7194	-	-	-
F-111G	-	B1-32 / 68-0260	-	-	-
F-111G	A8-259	B1-31 / 68-0259	30 August 1970	2 July 1991	October 1993
F-111G	A8-264	B1-36 / 68-0264	19 October 1970	27 August 1990	11 February 1994
F-111G	A8-265	B1-37 / 68-0265	28 October 1970	2 July 1991	24 September 1993
F-111G	A8-270	B1-42 / 68-0270	25 November 1970	4 June 1991	24 September 1993
F-111G	A8-271	B1-43 / 68-0271	15 November 1970	2 July 1991	14 January 1994
F-111G	A8-272	B1-44 / 68-0272	17 November 1970	-	10 May 1994
F-111G	A8-274	B1-46 / 68-0274	8 December 1970	21 May 1991	6 December 1993
F-111G	A8-277	B1-49 / 68-0277	24 December 1970	5 July 1990	25 March 1994
F-111G	A8-278	B1-50 / 68-0278	31 December 1970	16 July 1990	10 May 1994
F-111G	A8-281	B1-53 / 68-0281	31 December 1970	7 September 1990	6 December 1993
F-111G	A8-282	B1-54 / 68-0282	27 January 1971	10 November 1990	25 March 1994
F-111G	A8-291	B1-63 / 68-0291	30 January 1971	1 July 1991	22 October 1993
F-111G	A8-506	B1-68 / 69-6506	16 March 1971	9 November 1990	-
F-111G	A8-512	B1-74 / 69-6512	16 April 1971	1 June 1990	-
F-111G	A8-514	B1-76 / 69-6514	28 May 1971	22 August 1990	11 February 1994

(Sources: NAA: A10297, Block 469 – Aircraft Status Cards – F111, A8-126 to A8-141 (with gaps); AAP 7214.016 – F-111 Type Record; www.f-111.net)

The F-111G Acquisition – The Political Fallout

Senator Robert Ray’s announcement of the intention to purchase another 18 F-111s created a diplomatic storm, although it was more the media rather than the region that made the most noise. The commentary began with the Indonesian Ambassador to Australia, His Excellency Sabam Siagian, when he was quoted as saying that, although Indonesia was not alarmed by the purchase, ‘it might raise doubts about Australia’s stated commitment to closer defence ties with its neighbours and for a peaceful South-East Asia.’ The comment made front-page headlines and drew both positive and

negative reaction.<sup>20</sup> Astutely, Siagian recounted: ‘If the Australian Government deems it necessary to acquire more military aircraft, it surely must fit somewhere with the current strategic doctrine ... But is it necessary given the (strategic) shift in the Asia-Pacific region and the emerging network of regional security co-operation?’ The Keating Doctrine was certainly one of increased regional security cooperation, as vocally espoused by his Foreign Minister, Senator Gareth Evans, even when made at the expense of participation in more distant operations.<sup>21</sup> Suffering a sense of insecurity so prevalent at the time, Australian politicians felt



compelled to consult regional neighbours on military acquisitions, but the reverse was not the case.

Senator Ray was left to defend the deal, as Senator Evans had departed the country for a regional visit. Ray’s argument on the effective doubling of the RAAF offensive strike capability was not one of contributing to a post–Cold War regional arms race, but one of life extension of the fleet as no suitable F-111 replacement could be identified. The F-111Gs did not introduce any new capability into the region, nor was their acquisition due to changed regional threat perceptions by the Government. They were also within the recommendations of the 1991 Force Structure Review. Without air-to-air refuelling and a modern EW suite, the F-111G was hamstrung by geography and technology, so the deal was not seen as a capability enhancement.

Other regional partners were not so critical. Presenting a paper at a RAAF Air Power Conference held just a week after the announcement, Major General Datuk Ahmad Merican, the Commander Air Defence Command, Royal Malaysian Air Force, was asked by a member of the media about the purchase. General Merican commented:

Australia already has 21 F-111s. The additional F-111s which the Australian Government announced are being purchased are to replace, and also to update, the current aircraft. In the context of the Five Power Defence Arrangement, and as far as Malaysia is concerned, it augurs well. We have no direct objection to the additional acquisition.<sup>22</sup>

This dynamic requires further analysis. The post–Cold War environment had left two legacies: first, America was released from the burden of matching a threatening Soviet Union, and its position as sole superpower was cemented; and second, the economic prosperity enjoyed by Asia-Pacific nations was in part being converted into military hardware. Cheap deals from ex-Soviet sources provided modern technology, so Australia’s much heralded ‘qualitative edge’ was seen as steadily eroding. Prime Minister

Keating made statements about the need for greater Australian independence and called for a refocusing of national priorities. The Labor platform of defence in depth was designed to fight a defensive war, an outcome of the Dibb Review and subsequent 1987 White Paper of the Hawke years. With long-range offensive strike platforms, such as the F-111 and Collins Class submarine in inventory, the ADF could defeat an enemy well offshore, rather than have to face an enemy lodgement somewhere in the northern part of Australia.

The F-111G buy was considered by many defence pundits an overkill, while to others, it was simply unnecessary. Not everyone in Canberra was happy with the acquisition, probably because they were not consulted. The announcement was left up to the Department of Foreign Affairs to explain, and they hastily sent policy notes to all Australian regional ambassadors in an effort to still any troubled waters. Contrary to the expectation of complaints from Australia’s regional neighbours, there was little noise and the F-111Gs entered service relatively quietly.

**The Deseal/Reseal Disaster**

The final controversy to hit the F-111 program emerged during the 1990s decade. This issue became known as the deseal/reseal disaster, resulting from fuel tank maintenance undertaken between 1977 and 2001. Of all the problems the RAAF faced with the F-111, this had the most impact, as it forced a change in the RAAF’s culture, and heralded a complete reassessment of how the workforce was treated and managed.

Problems with the F-111 fuel system were to plague the aircraft for its entire life, resulting in one of the most distressing eras for RAAF personnel. The F-111 was able to travel the great distances it could for two reasons—the efficiency of the afterburning turbofan TF30 engine and the large capacity of the fuel tanks within the aircraft structure. Each tank was an integral component (there were no fuel bladders) and



RAAF

**Above**

A maintenance worker shows how cramped the tanks were. Clearly seen is the grey ‘goop’ that had to be removed and replaced.

had a polymer barrier of sealant applied on the inside to stop fuel leaks.

By 1973, the USAF aircraft were experiencing fuel leaks from the tanks in the fuselage, a matter reported to Australia by the RAAF Resident Engineer at General Dynamics, Wing Commander Bill Collins. The cause was chemical breakdown (called reversion) of the fuel tank sealants that had been used to fill the space between ‘sandwiched’ metal structures inside the tanks. Collins accurately predicted that this problem would affect the RAAF fleet. Within a year of aircraft delivery to Australia, problems with the sealant became apparent. An unacceptable amount of fuel was seeping out of the wings and fuselage

after refuelling. The sealant material, known as ‘goop’ to the maintenance staff, was breaking down within the tank structures, and the problem was referred to ARL to investigate.<sup>23</sup> The sealant was transitioning from its normal elastic to a semi-liquid form, an issue compounded by the lengthy time the aircraft spent in storage before delivery. The integrity of the fuselage tanks was most important, as these held the bulk of the aircraft’s fuel, but the bonded construction of the tanks and fuselage made external patching of the tanks difficult. Fuel would track through the joining seams in the aircraft structure from its source on the inside of the tanks. The point where the fuel exited the external skin of the aircraft could be metres from the source. Hence, the source of the leak on the inside of the tanks had to be found by internal inspection and then resealed.<sup>24</sup>

Long before the aircraft went into the first of four of what became known as deseal/reseal programs, it was known that temperature had a degrading effect

on the tank sealants, so some type of shelter from the tropical Queensland sun was deemed necessary. The solution was to construct two large carport shelters under which the majority of the F-111 fleet could be parked. Air Vice-Marshals Sutherland recalled the work was quickly approved, but construction had to be undertaken while aircraft operations continued.<sup>25</sup> However, and despite the carports providing significant cooling, by January 1976, the ‘reversion’ of the sealant had become such an issue that the Air Member for Technical Services was considering a Australian deseal/reseal program, much as had started in the US. He quoted a task of 2–3000 man hours per aircraft which he considered ‘was not a job for the RAAF’. The problem was that the sealant used between the faying surfaces (the interface between panels) meant it could not be removed unless the aircraft was disassembled. That was not an option.<sup>26</sup>

Consequently, a bead of a different sealant was applied along the seams, but this would not last indefinitely. The method of sealing the fuselage integral tanks was to apply the polyester adhesive sealant between the faying surfaces and into the structural voids. This was complemented by placing beads of sealant along seams and around fasteners within the tanks. However, the polyester sealant degraded over time, causing a rupture of the seal and hence a new fuel leak.

The task took the airmen at No 3 Aircraft Depot six months per aircraft—meaning it would not be until 1986 that the entire fleet could be completed. Before then, many aircraft would have to be grounded. Although the Government Aircraft Factory at Avalon was proposed as a potential contractor, the decision was made to keep the activity in-house, a choice that would bring terrible consequences 20 years later.

**The Deseal/Reseal Process**

The RAAF undertook the first deseal/reseal program on 12 aircraft at No 3 Aircraft Depot between October 1977 and February 1982.<sup>27</sup> The work was ‘dirty’ and smelly, so much so that a task-specific

hangar was constructed remote from the remainder of the workforce at the base. Following 24 hours of softening (repeated twice and in some cases three times) using a noxious chemical stripping agent called SR51, heated to 52° C and sprayed in the tanks through a ‘rig’ of garden sprinklers, the tanks were emptied and rinsed. Maintenance workers were required to crawl inside the fuel tanks to remove remaining sealant with a ‘water pick’ using a water pressure of 7500 psi. The hardest task was to hand clean the tanks, scraping any residual sealant which required the use of dental tools. Once clean, a new barrier coating followed by a coating of sealant was applied—a long and uncomfortable, manual process. Re-plumbing the tanks and integrity tests completed the activity. According to the Board of Inquiry Report:

They [the maintenance workers] worked in cramped and very unpleasant conditions, sometimes in unbearable heat and sometimes in near freezing temperatures, and they suffered chronic and occasionally acute exposure to the hazardous substances with which they worked. The resulting symptoms include skin rash, gastro-intestinal problems, headaches and loss of memory.<sup>28</sup>

The effect on individuals varied considerably, with some succumbing almost immediately to exposure to the chemicals involved in the program, while others continued with no apparent affects. Those affected suffered irreparable health problems and many contracted fatal conditions.

Despite the work done by the Depot, by 1980, the deseal/reseal situation was becoming critical as the fleet would take seven years to repair. The idea of sending the aircraft to the US was reconsidered, and while it meant that the problem could be fixed within two years, it came at far greater cost and involved more aircraft away at any given time.<sup>29</sup> The Talbot Report offered a solution which would have expedited the program and, by coincidence, prevented the health problems of the F-111 maintenance workforce many years later. Talbot

urged the RAAF consider that: ‘The use of civilian labour for the ‘dirty’ component of the F-111C deseal/reseal program should be investigated and implemented if found warranted.’<sup>30</sup> That recommendation was not taken up, but the queue of aircraft awaiting both CPLT and deseal/reseal was mounting. The CASAC agreed that the solution to clearing the backlog was to cycle the aircraft through CPLT at the Sacramento Air Logistics Center (SM-ALC) between May 1981 and December 1982, and at the same time, deseal/reseal the fuselage tanks of nine aircraft while they were in the US.<sup>31</sup> The work done at the Depot and at Sacramento was thought to have solved the problem for the aircraft’s life, but did not.

The USAF experience had shown that the sealant had a life of about seven years, so a further deseal/reseal program was needed from 1991. By 1989, six aircraft were unserviceable due to major fuel leaks, the repair of which was beyond the resources of No 3 Aircraft Depot. The only option appeared to be a civilian contract. The subsequent Board of Inquiry Report explained:

A number of options were examined for the conduct of the program, namely, at SM-ALC in the US, in Australia using 3AD [No 3 Aircraft Depot] or contractors, or a combination of these options. The relevant factors were the need to conduct a two line program to meet the constraints of ‘aircraft condition, annual fleet ROE, avionics update program and CPLT input requirements’, and the workforce shortages at Amberley. On 28 January 1990, the decision was made to release a Request for Tender (RFT) to Australian industry for a fuselage DR [deseal/reseal] program to be conducted at Amberley in RAAF facilities, commencing no later than 1 February 1991. This was in addition to a Letter of Agreement (LOA) that had been negotiated with SM-ALC to deseal/reseal a total of five RAAF aircraft. Although considered as an option, the completion of the Wings DR program already under way was not included in the RFT.<sup>32</sup>

The Hawker De Havilland Company was contracted in December 1990 and 17 aircraft were processed

through this second (fuselage) program between April 1991 and August 1993.<sup>33</sup> The work was undertaken at Amberley in refurbished Bellman hangars. The program was similar to that done previously except the use of the noxious SR51 chemical stripper was discontinued.<sup>34</sup> An additional five aircraft were processed through SM-ALC between March 1990 and March 1994 to complete the cycle.<sup>35</sup>

As expected, after a further seven years, another deseal/reseal program was necessary. The program ran between March 1996 and November 1999, and was the last. A new spray seal process had been developed by the USAF, and this method was applied to 22 aircraft of the Australian fleet, including eight F-111Gs. A further two ‘G’ models were resealed in the US. The spray sealant was applied over the old material, thus avoiding the time-consuming and labour-intensive deseal process. However, the airborne sealant was inevitably inhaled, ingested and absorbed through the worker’s skin, and caused a fresh set of medical problems to those exposed.

By early 2000, Fuselage Fuel Tank Spray Seal Program team members began to show symptoms of chemical exposure.<sup>36</sup> After a medical officer noted a number of fuel tank repair staff had presented with similar symptoms, he reported to the Commanding Officer of the maintenance squadron who suspended the spray seal program. The Officer Commanding of the Wing then convened a unit inquiry which quickly determined that the health problems under scrutiny went back decades. The spray seal program ceased in February 2000 and a full military board of inquiry was convened. Commissioned by the Chief of Air Force, Air Marshal Errol McCormack, the three-man Board of Inquiry, headed by Commodore K.V. Taylor, took statements from over 650 personnel and examined a mountain of documents.<sup>37</sup> Their inquiry took over a year and the report entitled *Report of the Board of Inquiry into F111 (Fuel tank) Deseal/Reseal and Spray Seal Programs*, was groundbreaking. It sent shockwaves through the Air Force hierarchy and the F-111 community. The RAAF was told that



‘in excess of 400 people [had] suffered long-term damage to their health’ and many who had worked on the deseal/reseal programs since the 1970s were suffering a range of unusual illnesses. What seemed certain in hindsight was that, even if a contractor had done the work, the outcome would have been the same.<sup>38</sup>

While not apportioning blame, the Inquiry identified several matters that had to be addressed. Importantly for the RAAF, there were several key themes which permeated the report. These included:

- the organisational causes and RAAF culture;
- the RAAF Flying Safety system that could have been used as a model;
- the priority of operations over logistics;
- the priority of platforms over people;
- lessons learned not being applied; and
- failure within the chain of command (specifically, the system to get information up the chain and the RAAF Medical/Occupational Health system).<sup>39</sup>

The finding which hit hardest to the new Chief, Air Marshal Angus Houston, was the priority the RAAF placed on platforms over its people. The RAAF had developed a ‘can do’ attitude, and a culture where performance equalled aircraft on line in the minimum time. This culture had been instilled in all ranks from the earliest times.<sup>40</sup>

There were several immediate outcomes from the Board of Inquiry. These included a major overhaul of safety management within the Air Force, with the establishment of the Ground Safety Agency; a major health study of the affected workers called the Study of Health Outcomes of Aircraft Maintenance Personnel (SHOAMP); the provision of ‘non-liability’ health care for those affected; and the development of an Adaptive Culture Program to redefine the RAAF’s values. Houston wanted to bring people back into the Air Force operational equation. Additionally,

the Chief of the Defence Force, General Peter Cosgrove, directed that the recommendations from the Inquiry be implemented across Defence, as many of the areas found wanting under Air Force were replicated ADF-wide.

The major outcome for the RAAF was a realisation that the Air Force had let the F-111 maintenance workforce down, and that occupational health and safety on the ground was as important as flying safety was in the air. The Ground Safety Agency formed, and among its first duties was the development of an education program. Specific procedures for fuel tank entry, including risk management strategies, were published, and training included specific tank entry procedures using a GF-111A specifically acquired for the purpose.<sup>41</sup>

### The Study of Health Outcomes

The Board of Inquiry Report was not the end of the matter. In April 2000, the Minister Assisting the Minister for Defence directed an epidemiological study of the health of personnel involved in the various deseal/reseal programs. In 2002 this became the SHOAMP and was conducted in three phases. The first phase included a literature review of the evidence between solvent exposure and health outcomes; a qualitative study of those involved; and the development of a protocol for conducting a more general health and medical study. The second phase examined mortality and cancer outcomes within the exposed group relative to the wider population. The third phase was a general health and medical study beyond the F-111 experience.<sup>42</sup> The SHOAMP reported between July 2003 and September 2004 and led to the Department of Veterans’ Affairs taking up the case.<sup>43</sup> In December 2004, the Minister for Defence and the Minister for Veterans’ Affairs co-announced the Government’s response to the study. A lump sum benefit was offered to personnel who worked on the program, in addition to any other compensation. In August 2005, the Government announced that a one-off ex gratia payment of either \$40 000 or \$10 000 would be made, depending

on each claimant’s length of time on the program rather than on their medical condition.<sup>44</sup> This drew immediate criticism and was the cause of further stress to claimants and their families. However, the ex gratia payment was not compensation as that matter had to be decided either administratively or through the courts.

Those who had suffered and, in the case of deceased members, their families were outraged by the amount on offer and the conditions set. By 2008, the Department of Veterans’ Affairs had received over 500 claims for compensation for a combination of medical conditions, including neurological, psychiatric, various rare carcinomas and, specifically, leukaemia.<sup>45</sup> In addition, a total of 33 persons elected to pursue the Government under ‘common law’ for further compensation. Some of those claims were still before the courts in 2010. Adding further stress, many claimants for the ex gratia payment were deemed ineligible as they had not been involved in the formal deseal/reseal programs. These workers had been employed in the ad hoc tank resealing, called ‘pick and patch’, but were not exposed to the stripping agents. As a consequence, they did not qualify.

Following lobbying of the Government and the Opposition for an inquiry into the previous Government’s response to SHOAMP, the new Labor Government agreed in 2007 to further investigate the matter. The Minister for Veterans’ Affairs, Alan Griffin, referred the matter to the Joint Standing Committee on Foreign Affairs, Defence and Trade (JSCFADT) in May 2008 for them to consider.

### The JSCFADT Committee Review

Chaired by the Hon. Arch Bevis, the JSCFADT convened their inquiry into the deseal/reseal program, with specific consideration of the impact on the workers and their families. The inquiry’s terms of reference focused on three aspects. First was the adequacy and equity of the Health Care Scheme in meeting the health and support needs of participants and their families, and whether this was

consistent with the SHOAMP findings. Second was the adequacy and equity of the financial element of the ex gratia scheme and whether it was consistent with the findings of SHOAMP, the Health Care Scheme response, the Tier definitions, and the one-off payments to other veteran groups. And third was whether the overall handling and administration of ex gratia and compensation claims was appropriate, timely and transparent for both participants and their families.<sup>46</sup>

The inquiry examined 130 submissions, held public hearings in Brisbane and Canberra and took over a year to consider the issue. While it could not change the ex gratia payment schedules, the Committee recommended an extended eligibility to over 2000 affected members, and made a further 17 recommendations, many of which were already being actioned by Defence and the Department of Veterans’ Affairs. At the time of writing, the Government was considering its response to the report from the Parliamentary Inquiry, but the 2010–11 Budget did not provide for either additional compensation, nor a rise in the ex gratia amount.<sup>47</sup>

For the RAAF, one of the outcomes from the deseal/reseal disaster was a realisation that, in disbanding Support Command and in implementing the commercialisation programs that followed, the Service had lost the expertise needed to assist No 501 Wing solve the deseal/reseal problem. There was no corporate knowledge or expertise left, and no response team able to assist. Unfortunately, the legacy of the deseal/reseal program will remain for a long time. At the time of writing, the issue was ongoing with those affected still seeking compensation from Government. Lessons were learned, but came too late to help many of the sufferers. The financial cost to the Air Force, Defence, Department of Veterans’ Affairs and individuals, was enormous in terms of the inquiries, the health study, the ex gratia payments, compensation, lost income and financial hardship.<sup>48</sup> The effects on capability were also considerable, and the ongoing emotional cost to those involved and their families incalculable.

The effects of the deseal/reseal programs will remain for decades.

**A New Role – Precision Air Support**

The idea of using the F-111s for precision strike was not new. The aircraft were delivered in 1973 with the capability to drop bombs using a radar offset beacon, signalled from the ground. The beacon offset bombing mode allowed crews to bomb a target at a preset range and bearing from a ground radio beacon, and thus prevent friendly casualties. A small beacon handset could be used by Special Forces or a tactical air controller to designate their location and provide range and bearing coordinates to a target. The capability was developed out of the US Vietnam

experience, and was demonstrated to crews when training in the US prior to the 1973 pick-up. It was adopted by the RAAF in the mid-1970s after beacons became available. The beacon mode allowed the F-111 to directly support troops on the ground, a feature of great utility to the Army.

For the first two decades, the concept of operations for the F-111 was to fly a single aircraft, night TFR attack against a single high-value target. Updated targeting systems and modern precision weapons changed that. The idea of Precision Air Support or PAS began after the incorporation of *Pave Tack* in the mid-1980s. Perhaps the PAS genesis was the previously mentioned ‘attack on F Block’,<sup>49</sup> or perhaps it came from a two-day media awareness campaign conducted in late 1988. This involved showing *Pave Tack* night imagery of the four major TV channel stations in Brisbane—the video was released to demonstrate to the general public the resolution of this new targeting system. Or perhaps it was the

**Below**  
A8-132 over China Lake carrying four GBU-24s.



RAAF

simultaneous release of numerous clips of *Pave Tack* imagery of a doorknob on Fort Denison on Sydney Harbour taken from medium altitude that won the

media over. Whatever the genesis, the aircrew of the day knew they had something special; their challenge was to learn how to exploit its full potential.

**The First Female Aircrew**

An indication that the RAAF had matured as a Service was the posting of female aircrew to fly the F-111. The all-male domain of fast-jet aircrew was broken by the arrival of the first female aircrew member, Flight Lieutenant Melissa Brauman, a pilot who began No 45 Conversion Course in 1997. Unfortunately, Brauman elected not to complete conversion for personal reasons, so the honour of being the first women to fly the F-111 as operational aircrew went to Flying Officers Brooke Chivers and Aroha Fifield, both navigators, who arrived in 1999 to undertake No 48 Conversion Course.<sup>50</sup>

The arrival of women into the fast-jet world was significant for the RAAF as the ‘glass ceiling’ for women in the strike profession had finally been broken. It came at a time when the Government was pushing equality for women as policy, and the Services were being pressured by ministers to have more women in high-profile positions. The announcement of the two women’s graduation coincided with the appointment of Air Commodore Julie Hammer to senior rank, also a female first. Of the three Services, the RAAF won much kudos.<sup>51</sup> Since then, five others have passed into the F-111 squadrons, four of whom were navigators and one from the new category of Air Combat Officer.<sup>52</sup>



82 Wing

The first female F-111 aircrew: Flying Officers Aroha Fifield and Brooke Chivers.



The latest White Paper (DOA 87) forced the Strike Reconnaissance Group to think laterally, beyond the traditional strike mission as their *raison d'être*. Low-level and escalated low-level contingencies foreseen in the policy required fresh thinking if the F-111 platform was to remain relevant to the ADF mission. From 1989, No 1 Squadron, as the initial, sole operator of the *Pave Tack* system, led the way with the development of PAS and *Pave Tack* Tactical Reconnaissance (PTACRECCE) concepts—developed under the tutelage of Wing Commander Peter Criss.<sup>53</sup> The crews, in conjunction with Army Special Forces operating in the Northern Territory, developed new target detection, tracking and attack procedures using previously untried techniques. These newly-developed applications had utility across the ADF, and were quickly adopted to support all surface forces. Over subsequent years, PAS and PTACRECCE procedures were further refined, and the role was formally incorporated into strike reconnaissance doctrine.<sup>54</sup> PAS employed either medium or high-altitude bombing techniques using *Pave Tack* and LGBs, the utility of which was graphically illustrated during the First Gulf War in 1991. While further details of these operations remain classified, the harmonisation of air and ground forces exploiting the attributes of responsiveness, range, duration on target, and precision offered by the modified F-111s, afforded the ADF a new capability that was subsequently adopted by the US and the UK.<sup>55</sup> This role, together with an enhanced Harpoon maritime strike capability, preserved the F-111 in the RAAF inventory during the period of further budget stringency of the late 1990s, and guaranteed Army support for the aircraft in the face of bureaucratic attempts to have the F-111 axed.

**Becoming the Sole Operator**

Throughout the 1990s, while the RAAF had placed its faith in the F-111 and had invested heavily in upgrades and modern weapons systems, the USAF was considering its options for aircraft retention.

The end of the Cold War and a general drawdown of US Forces after Gulf War I meant the F-111's days in USAF service were numbered. The last USAF strike F-111s retired in July 1996 and the last EF-111As (the electronic warfare version of the F-111) in 1998. Given the sunk cost to Australia, in 1992 it was announced that the RAAF's F-111s would be life extended to 2020. This meant the RAAF would become the sole operator, with a corresponding reduction in interest and support from the USAF and US industry expected. Consequently, in 1997, the F-111 Aircraft Sole Operator Program (SOP) was established to ensure that the F-111 could continue to be maintained in-country for the remainder of its service life. Under SOP, there were two sub-programs: the Structural Integrity Program SOP and the TF30 SOP.

Under the Structural Integrity Program, a consortium was formed between the RAAF, DSTO and AeroStructures, an Australian company specialising in aircraft metals.<sup>56</sup> To gain the requisite knowledge, members of the consortium were posted to Lockheed Martin at Fort Worth between 1998 and 2000, where they worked on several specialised tasks. These included the development of computer models of the entire F-111 airframe, the establishment of an indigenous maintenance data capability, the conduct of numerous studies and a review of external aircraft loads.

Concomitant with the SOP, DSTO at Fisherman's Bend were engaged in wing and fuselage tear down of an ex-USAF F-111A (Serial No. 67-0106) which arrived in November 1999, and in the development of in-country crack analysis techniques and database.<sup>57</sup> This particular F-111 airframe was originally planned to be one of the F-111A attrition buys in 1982, but was rejected on fatigue grounds. The airframe was indicative of a 30+ year-old aircraft and was considered representative of the RAAF fleet. The teardown took almost four years to complete and was intended to ensure there were no latent defects in the F-111 build. The scientists found low levels of corrosion and little evidence of fatigue cracking in



DSTO

**Above**

DSTO staff working on 67-0106 at their Fisherman's Bend facility.

as-then unexamined structures. This gave peace of mind to the RAAF, who at the time wanted another 20 years service out of the F-111 fleet.

Under the auspices of the Structural Integrity Program SOP, four wing tests were undertaken: the Wing Optimisation Modification (WOM), the Wing Damage Enhancement Test (WDET), the Wing Damage Tolerance Test (WDTT), and the F-111 Wing Economic Life Determination (F-WELD) test. Full details of these tests are beyond the scope of this

work; suffice to say they were designed to extend the life of the F-111 wing and associated structures.<sup>58</sup>

The second program under SOP was the TF30 engine program. This became necessary since the RAAF, as the sole user of the F-111 variant of the TF30 engine, would be left with a small number (about 100) of engines, although there was some compatibility with the engines in the USN’s F-14. For the first 20 years of its service with the RAAF, the TF30 fleet was managed according to the manual: strictly on a ‘safe life’ philosophy, with specific, mandated service and overhaul intervals. During this time, DSTO had been involved in engine low cycle fatigue studies, structural analysis studies, and rectification of a number of other problems.<sup>59</sup> By the early 1990s, staff at the TF30 Engine Business Unit at Amberley realised they had to become more efficient if they were to avoid having their work contracted out. They implemented improvements to reliability, availability and maintainability by introducing condition-monitored maintenance. This was called the Reliability, Availability and Maintainability (RAM) program, and reduced engine support costs from 30 per cent to 10 per cent of the F-111 weapon system total support cost—a remarkable achievement.<sup>60</sup>

While Pratt & Whitney continued to support the TF30 program, it was evident that their expertise and interest would dwindle and support costs would rise once the USAF F-111 fleet was withdrawn. It was only a matter of time before the RAAF called upon DSTO’s expertise to assist. DSTO’s first major contribution under SOP was the development of a spin test facility used to validate engine component life. This facility was another ‘first’ for Australia and was later extended for use on the T-56 engine which powers the C-130 and P-3C aircraft.

The second major contribution of DSTO was in engine condition monitoring and hot section durability. This involved the development of thermal barrier coatings, engine component crack detection methods and new methods of component repair.<sup>61</sup> Perhaps the most significant of all these programs

began in 1994 when cracks were found in several engine combustion chambers after 750 operating hours. DSTO engineers tackled this problem in two ways. First, they built a perspex model of the combustion chamber to visualise the gas flow; and second, they experimented with thermal barrier coatings used to reduce temperature and therefore reduce crack growth.<sup>62</sup> The TF30 sole operator challenges were mitigated by a combination of strategic fleet planning, innovative upgrade strategies, contingency spares management, and judicious insertion of technology. In 2008 the Sole Operator Program was successfully concluded.

Upgrades Continue to Life of Type

With the arrival of the F-111Gs, Australia again had a viable F-111 fleet, so in 1996, a study called ‘Strike Reconnaissance 2020’ considered the F-111 life of type. It recommended the ‘G’ models be used for training, and the ‘C’ models for major exercises and operational deployments, thus ensuring the fleet would last. The Government later in the decade had announced 2020 as the withdrawal date, so it made good sense to continue to upgrade the aircraft. In the 2001–2010 Defence Capability Plan, at least 21 projects had an impact on the F-111 and these are listed in Table 7–2.

Not all would get funding, but those considered key are described later in this chapter.

East Timor Operations

Significant for the history of the F-111 was the only ‘operational’ use of the aircraft in its 40 years of service with the RAAF—the United Nations operation in East Timor in 1999.

After nearly 25 years under Indonesian occupation, on 11 June 1999, the United Nations Mission in East Timor (UNAMET) was established with police, military and civilian observers deployed across the country to organise and monitor independence elections.<sup>63</sup> On 30 August, the East Timorese

Table 7–2: 2001–2010 Defence Capability Plan F-111 Projects

Project	Details
Air 5136	ATE – Harris intermediate level test stations
Air 5208	F-111 replacement simulator Phase 1 – acquire ex-USAF F-111F sim Phase 2 – modification by Wormald to AUP standard
Air 5225	Phase 1 & 2 – AUP upgrade Phase 3A & 3B – F-111C/G commonality Phase 3C – F-111G acquisition
Air 5393	Link 16 installation
Air 5391	Phase 2 – interim EWSP capability - CMD5/ALE-40 Phase 6 – interim EWSP capability - RWR/ALR-62(V)5 Upgrade of ALE-40 to ALE-47 Phase 7 – interim EWSP capability – jammer pod with DFRM -ELTA EL/L-8222
Air 5395	Air Combat Training System Phase 2 – Cockpit data recorder Phase 3 – Air Combat Training System Pod integration
Air 5398	Phase 1A – Stand-off weapon – AGM-142E Phase 1B, 2, 3, 4, 6 – Follow-on Stand-Off Weapon
Air 5404	F-111 Strike Capability Enhancement Phase 1 – Capability optimisation, Fleet commonality component purchase (ALR-2002 RWR) Phase 2 – Capability optimisation, F-111G precision weapon/maritime strike capability mod – incorporation of Laser IR designator system, upgrade of mission computer and SMS, GPS installation and programmable display generator
Air 5408	Phase 2 – GPS enhancement
Air 5409	Bomb Improvement Program Phase 1 – improve stand-off capability – GBU-31/32/35 series and/or JDAM
Air 5412	WVR missile and Helmet mounted cueing system – AIM-9M replacement
Air 5416	Interim EWSP capability ( <i>Project Echidna</i> ) – replaces Air 5391 and 5394 Phase 1 – ALR-2002A Full-scale Engineering Development Phase 2 – Elta EL/L-8222 Phase 3 – ALR-2002A, integration of missile approach warning system (MAWS)
Air 5418	Follow-on Stand-off Weapon – replaces Air 5398 Phase 1 – Anti-radar/radiation SOW, area SOW and littoral SOW (100 nm+) Phase 2 – Hardened target weapon
Air 5421	Tac Recce and Strike support Capability (RF-111C upgrade) Synthetic aperture radar, LOROP system
Air 5422	F-111 Block Upgrade Program
JP 129	Risk mitigation phase – Raytheon DB-110 Raptor Reconnaissance Pod trials
JP 2008	MILSATCOM
JP 2036	Phase 2 – Advance Narrow Band Digital Voice Terminal
JP 2043	HF Mod
JP 2045	Phase 1A – Sea mining capability Phase 1B – Stand-off mining Phase 2 – Stand-off mining
JP 5408	GPS enhancement

Source: *Defence Capability Plan 2001–2010: Public Version*, Defence Publishing Service, Canberra, 2001



voted overwhelmingly for independence and pro-Indonesian militias railed against the decision and began a period of violent unrest. Consequently, on 15 September 1999, the United Nations Security Council unanimously authorised the establishment of a multinational force for East Timor under Resolution 1264, and UNAMET was replaced by INTERFET (International Force East Timor) with an Australian lead.

After the pro-independence vote, the situation on the ground changed dramatically. Threats to UNAMET and Australian nationals, as well as to the East Timorese, lead to the insertion of Australian peacekeeping troops which began on 6 September 1999 with Operation *Spitfire*. This was a pre-emptory operation designed to gather intelligence about the situation and evacuate Australian nationals, particularly important given the rising tension between Indonesian-led militias and the Australians in country due to the Australian Government's support for East Timor. Operation *Spitfire* ended on 19 September 1999 and was replaced by Operation *Warden* (the INTERFET force deployment).

Australia was seen by some as interfering in Indonesian internal matters, so the situation on the ground was volatile. As tensions were mounting, the Chief of Air Force, Air Marshal McCormack, urged caution against using the F-111s, conscious that 'they were too politically sensitive'.<sup>64</sup> His concerns were overridden. It was during the immediate lead up to the independence elections that F-111s were deployed forward to RAAF Base Tindal for reconnaissance, and to prepare for possible hostilities. Requests for overflight in support of Operation *Spitfire* and Operation *Warden* were initially refused by the Indonesian Air Commander, Air Marshal Santoso; however, after Indonesian forces withdrew from East Timor in late October, reconnaissance flights began six days later on 5 November with Indonesian consent.<sup>65</sup>

With tensions building from August, Nos 1 and 6 Squadrons deployed to RAAF Base Tindal with six

aircraft and about 100 personnel. The deployment lasted from 28 August to 15 December—although originally intended to last for only two weeks, it was extended in support of Operation *Warden*. While contingency planning for the elections had been underway for some time within Government, it had been kept close hold. The Commanding Officer of No 1 Squadron, Wing Commander Kym Osley, was aware of the situation, but had not been briefed on any of the RAAF deployment plans, so it came as somewhat of a surprise to him when No 1 Squadron crews and F-111s were placed on short notice to move, and then deployed from Amberley to Tindal on 28 August.<sup>66</sup>

The operational security was so good at the time the aircraft deployed, that the first the Base Commander at Tindal heard of the imminent arrival of a formation of F-111s and a C-130 with ground crew, was when Osley called him immediately before the F-111s took off from their home base at Amberley. Once the aircraft arrived at Tindal, word soon leaked out.<sup>67</sup> Given the F-111 flying activity around the Northern Territory, and lack of it at Amberley, it was clear to the media and regional nations that a significant F-111 force was deployed to Tindal in support of the East Timor operation. On 9 November 1999, *The Sydney Morning Herald* announced that Australia's F-111s had been operating over East Timor conducting reconnaissance for INTERFET, although the Indonesian authorities already knew all about the flights 72 hours beforehand.<sup>68</sup> The RAAF required diplomatic clearance before the flights, and this had to be cleared through Jakarta.

For their time at Tindal, the F-111Cs stood at readiness, two being loaded with concrete bombs fitted with laser guidance kits and on standby at all times. If needed for precision air support missions, these bombs, while extremely accurate, would not cause as much damage as those filled with high explosive. However, like the Gulf War a generation before, the crews were ready to go but were never needed.



Osley

**Above**

Wing Commander Kym Osley, CO No 1 Squadron, gets the traditional 'hose down' at Tindal after the last East Timor sortie.

Meanwhile, ARDU had been trialling a Raytheon DB-110 optical and IR reconnaissance system fitted in an underwing pod as part of the sensor definition phase for JP 129, the Tactical Unmanned Aerial Vehicles Project.<sup>69</sup> The presence of this aircraft in the Northern Territory at this time led to speculation that it was tested operationally over East Timor, but this has not been confirmed. Nevertheless, together with a second RF-111C, the aircraft produced high quality photos of the East Timor operational area allowing INTERFET forces to update their knowledge of infrastructure and prepare better ground maps.<sup>70</sup>

The last East Timor overflight was on 9 November 1999 after which all aircraft were stood down, but held at Tindal pending a changed circumstance. The detachment eventually returned to Amberley and normal operations in mid-December. The Tindal deployment, while of relatively short duration and low intensity, was the only time in their history that the F-111Cs were used operationally. Whether they had any deterrent effect is not known, but according to Osley:

I have no doubt that the deployment of the F-111 force to Tindal was duly noted by the wider region and was a deterrent to escalation of regional military support to militias within East Timor, and also a deterrent to external interference with INTERFET military forces ... It certainly underscored in a very tangible way the Australian Government's commitment to supporting the East Timorese people.<sup>71</sup>



While low key, the deployment had its effect, and Australian troops on the ground in East Timor never came under significant military threat.

**CPLT in Australia**

The Cold Proof Load Test (CPLT) concept was covered in Chapter 4, but with the RAAF becoming sole operator from 1998, and with a life extension till 2020, the RAAF now had to complete the CPLT in Australia. This meant establishing a CPLT chamber and a fleet-wide test regime.

A CPLT was required after 2000 flying hours to ensure aircraft were safe for flight for a further 2000 hours. Consequently, after the first seven years of

operations, the F-111C fleet was due to be retested. This meant the aircraft had to be ferried to the Sacramento Air Logistics Center (SM-ALC) in the US, as no such facility existed in Australia. SM-ALC was the dedicated F-111 deeper maintenance facility used by the USAF, where a cold proof chamber had been constructed in the early 1970s. The cost of cold proofing was US\$259 000 per aircraft, and this reignited debate about F-111 running costs and the aircraft's continued effectiveness. Getting the aircraft safely to retirement in 2020 would cost over A\$1m each.

With the withdrawal of the USAF F-111 fleet and the closure of McClellan AFB in 2001, Australia was faced with the problem of maintaining F-111 integrity and flight safety, so the only option was to recreate a CPLT facility in Australia. Amberley was the logical site as all deeper maintenance was already being carried out there. Consequently, Lockheed Martin (into which General Dynamics Aerospace

Division had been absorbed through merger) was contracted to build the facility. The CPLT hangar was commissioned on 26 July 2001 and was assembled from an ex-US CPLT facility from Bristol in UK, and some locally sourced components. In August 2004, it was announced that Boeing would take over management of the facility, and a smooth transition occurred over the following 12 months.<sup>72</sup> Boeing operated and maintained the facility until early 2009 when it was decommissioned after the final CPLT was complete. While the CPLT program was a success, it was not the end of the F-111 wing cracking problem.

**The 2002 Wing Crack and the Wing Recovery Program**

In early 2002, an F-111C wing test specimen cracked during Wing Damage Enhancement Test (WDET) testing at the DSTO Laboratories in Melbourne. The test was examining the strength and resilience of an area of wing subject to a boron doubler patch, but a multiple failure of a poor quality Taper-Lok hole occurred where it was not expected in an aft section. The test began on 17 March 2000 on a wing which had already accumulated over 5400 flying hours. After a total of 8000 hrs, the boron doublers were removed to see if the wing could remain structurally safe, and testing recommenced. After just 89 hours testing, the wing broke. On further inspection, other poor quality holes were discovered, most of which had started to crack before the test began.

As in the late 1960s, the fleet was grounded while inspections and a further study were carried out. The fleet was returned to the air later in February 2002, but with severe restrictions, until a wing recovery program could be carried out on 15 aircraft.<sup>73</sup> By the time of the wing crack, Australia's fleet of 35 F-111s was, in reality, down to 28 flying aircraft, with the remaining seven in storage as 'attrition spares'. Online availability was extremely low, and news of the problem made the international press.<sup>74</sup> The DSTO report on the break stated in part:

Based on the test result, a fatigue life analysis showed that many F-111C model wings were already approaching the calculated interim safe life. The strong likelihood that other wings could contain similar poor build quality led to the decision by the RAAF to source replacement wings for the Australian F-111 aircraft fleet.<sup>75</sup>

At the time of the break, the RAAF had four wing sets in storage and hurriedly acquired a further 26 F-111D and F-111F short wing sets from AMARC, with initial deliveries commencing in early June 2002.<sup>76</sup> The short wings would later be modified to the 'C' model long wing configuration. Due to this unforeseen failure, operations of the F-111 were conducted for a short period at higher levels of risk than would normally be accepted. This situation was remedied with a subsequent DSTO wing structural test (called the F-111 Wing Economic Life Determination – F-WELD) which accumulated enough test hours to confidently assess that the risk of structural failure lay within acceptable limits.<sup>77</sup>

The outcome of the Wing Damage Enhancement Test, although unfortunate and time consuming, vindicated the reason the tests were done in the first place. Not only had previously unknown cracks been discovered, but personnel safety had not been compromised. Further tests, such as the F-WELD, ensured the 'D' and 'F' model wings would be safe for life of type. F-WELD used an F-111F wing which had seen service in the USAF, so there was much speculation and debate about applying a RAAF flight load spectrum over a USAF spectrum for the test. The USAF had operated the short wing F-111F to +6 g, whereas the RAAF's longer wings were limited to +4 g. DSTO engineers used the F-111 simulator at Amberley to calculate the load spectrum and the tests ran from August 2004 for three years. They were suspended in June 2007 when a complete tear down was undertaken to allow a thorough inspection for cracks. Enough data was gained to ensure the wings would last through life of type and the replacement wings were fitted to the fleet.<sup>78</sup>

**Below**

The Australian CPLT hangar showing the set-up. Fans were used to circulate the air to ensure a constant temperature.



RAAF



**Enter Boeing as Prime Contractor**

In January 1990, to support the Avionics Update Program (AUP), Rockwell Australia began operations in Queensland with the arrival of a single employee from their Victorian office. The Rockwell office was a converted family room in a local Ipswich home.<sup>79</sup> By 1993, the company had 75 personnel working on the AUP program with a 120-day schedule set for each aircraft conversion. In 1996, Boeing acquired

Rockwell Australia as part of its global merger, and a year later moved their head office out of Sydney to Brisbane.<sup>80</sup> Boeing now entered the world of the F-111 with work commencing on the AUP in April 1997.

By 1997, commercialisation pressure had returned, this time under the Defence Reform Program, and Boeing began to pursue No 501 Wing business for deeper maintenance and support contracts. Industry had previously missed out, so they teamed to outbid the in-house option. Boeing joined with Qantas, Thompson-CSE, Rosebank Engineering, Harris and BAe Australia. Market testing of the deeper maintenance aspects of No 501 Wing was directed to occur before 30 June 2000. Four RAAF Business Units (BUs) were identified as candidates: the Weapons System BU, the Avionics BU, the Engines BU and the Workshops BU. The contract would be

for an initial 10 years with an option on another 10 once the RAAF made up its mind about the aircraft’s withdrawal date. Total market value would potentially be A\$3b and the program would run till 2020.<sup>81</sup>

In August 2000, Defence Minister John Moore announced Boeing as the preferred tender for the Amberley Weapons Systems Business Unit (WSBU) and for the complementary Block Upgrade Program (BUP). Two separate contracts were awarded for A\$500m, each for 10 years.<sup>82</sup> The Engine BU would remain in-house and the Avionics BU outsourced to another company. Subsequent to that, Boeing also won the contract for life-of-type support of the F-111 fleet and, thereby, became the major industry partner that would see the F-111 out to retirement.

Although General Dynamics originally built the F-111, and the Lockheed Martin Company acquired

the company in the early 1990s, after the USAF retired their F-111 fleet in 1998 Boeing officially became the Original Equipment Manufacturer (OEM). Boeing received OEM status partly ‘because of the extensive modifications made to the [Australian] fleet and because the RAAF is the last operator’. Boeing also acquired the Design Authority Certificate for the type, allowing the company to legally make modifications while keeping the aircraft airworthy.<sup>83</sup>

After some initial antagonism against Boeing when the company took over deeper maintenance in 2001, the relationship with Boeing steadily grew. The change of heart by the RAAF regarding contracting out F-111 maintenance occurred for several reasons, apart from government policy. First, the USAF retirement of the F-111 fleet meant the USAF and US industry would soon lose interest in F-111 support.

**Below**

Hangar 410 at RAAF Base Amberley, pictured in 2003, was the location for all R4 and R5 servicings performed by Boeing. The unpainted silver tail of the aircraft in the foreground resulted from the regular practice of stripping the aircraft prior to deeper maintenance.

**Opposite**

Boeing employees performing an R4 servicing on ‘G’ model A8-506 in 2003 in Hangar 410 at RAAF Base Amberley.



Boeing



Boeing



Second, the aircraft was always manpower intensive, and the Government direction downsizing the RAAF from 21 000 in the early 1990s to 13 500 by 2000 meant the RAAF would have problems manning the positions at No 501 Wing and the flying squadrons. Third, and perhaps more importantly, Australian

**Below**

A Boeing employee removing the windscreen centre beam of the crew module during the Avionics Upgrade Program (AUP) in the late 1990s. Under the AUP, Boeing converted from analogue to digital the avionics on 21 ‘C’ model aircraft, which included the removal of 12 127 wires and their replacement with 14 080 wires. The last AUP modified aircraft, A8-148, was officially handed over to the RAAF at a ceremony on 17 November 1999.

**Opposite**

Boeing employees, defence officials and other guests in front of A8-135, the 28th and final F-111 serviced by Boeing under the deeper maintenance program. A ceremony was held 4 November 2009 at RAAF Base Amberley to mark the occasion.



Boeing

industry had matured to the extent that it could compete internationally for this kind of work and produce a quality outcome.

Many RAAF airmen displaced by the commercial support activities joined the Boeing organisation, providing continuity of knowledge and maintenance expertise, and forging a closer relationship between customer and supplier. Boeing moved into hangar 410 at Amberley, so little changed other than the sign above the hangar entrance. Other minor industry partners also contracted to help maintain the F-111 fleet. The Avionics Business Unit was run by Raytheon (previously Honeywell), the Workshops Business Unit by Tasman Engineering Australia (a subsidiary of Air New Zealand) who specialised in precision machining, and Rosebank Engineering maintained the aircraft's hydraulic systems. This integrated engineering approach allowed the RAAF to focus on training, operations and exercises, and became a win-win for everybody. After all the stress of the contracting out process, the relationship between the RAAF and industry became symbiotic once each developed trust in the other.<sup>84</sup> The first F-111 aircraft Boeing inducted into its maintenance system was A8-114 on 29 November 2001. The service took 48 weeks and was highly successful, providing further confidence that the new system would work.

Perhaps the clearest indicator that Boeing had brought with it considerable expertise in engineering and major aircraft repair came with the rebuild of A8-112, which had suffered a fuel tank explosion over Darwin in June 2002. Electrical arcing inside the tank set off the fuel-air mixture. The aircraft successfully recovered to the Darwin base but had extensive damage to the forward fuel tank. Because the extent of the damage was unknown, the aircraft had its wings, nose and tail removed before it was brought back to Amberley for investigation. The repair became the largest structural engineering project undertaken on the RAAF's F-111 fleet. Boeing engineers had to remove the forward fuel tank and sections of the forward weapons bay for the



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repair work. A new in-house build of the shattered bulkheads and parts of the floor, as well as the fuel tank, were necessary as was a redesign of the fuel electrical cable conduit to prevent a recurrence. The repairs took 18 months, and A8-112 flew again. Three days later it hit a large bird shattering the radome and resulting in a return to the hangar for yet more repairs. Some said the aircraft should have been written off, but the damage was again repaired and the aircraft returned to service.

Boeing's deeper maintenance work on the F-111 concluded in October 2009 with completion of the last of the scheduled major servicings. On 4 November, aircraft A8-135 was officially handed back to the RAAF at a special ceremony to mark the occasion.<sup>85</sup> Perhaps ironically, it was with Boeing that the F-111 concept really started, and with Boeing it ended 50 years later.

**The Engine Upgrades**

One of the best features of the F-111 was its engines. Called the TF30, they were designed by Pratt & Whitney in the early 1960s for the USN's F-6D

Missileer aircraft, which was later cancelled in favour of the F-111B. The engine was the world's first high-bypass, afterburning turbofan—technically, a 16-stage axial-flow dual-compressor turbofan with a five-stage afterburner developing 10 000 lb thrust dry, and 18 000 lb in full afterburner.<sup>86</sup> After reliability problems with the original TF30-P-1 fitted to the F-111 prototype which had a propensity to compressor stall under various flight conditions, the 'as delivered' F-111As and F-111Cs were fitted with the much improved TF30-P-3 variant.

The RAAF contributed funding to the Pratt & Whitney TF30 Engine Component Improvement Program from early 1978. This gave Australia access to US defect investigations, studies into improvements to overhaul times, access to engine developments, and information on new inspection procedures.<sup>87</sup> This was to pay dividends as further developments to the engine design and performance came along. At that time, the TF30 had spawned several variants and was fitted to the F-111, F-14 and A-7 aircraft fleets, so there was substantial further development. The TF30 family is shown in table 7–3 below.



By 1985, the manufacturers had recommended enough modifications for the TF30-P-3, P-7 and P-9 engines for them to be renamed the TF30-P-103, P-107 and P-109 respectively. The difference included the addition of what was termed the *Pacer 30* program—57 modifications, which were mostly engine life extension and reliability improvements. The program justified extending the 500 engine hours servicings to 750 hours, and for overhaul from 1000 hrs to 1500 hrs—a significant saving. The first locally modified engine was handed over from No 3 Aircraft Depot to No 482 Squadron on 19 December 1985. From June 1986, all engines undertaking overhaul were upgraded to P-103 status.<sup>88</sup> To ensure reliable operation and to gather performance data, the 109 engines went through a 20-hour flight test program using F-111 A8-132 after it returned from prototyping the AUP.<sup>89</sup>

The acquisition of the 15 F-111Gs from the early 1990s brought with it another TF30 variant—the TF30-P-107. The P-107 was a ‘straight through’ engine design, while the P-103 and P-109 had a 3° upward tilt, so that F-111C and F-111G engines were not interchangeable. With the withdrawal of

the F-111 from USAF service in the mid-1990s, a number of the more modern TF-30-P-109 engines became available from mothballed F-111Ds and EF-111As. These gave 12 per cent higher thrust and were more reliable, and as the P-103 engines were becoming unsupportable, the RAAF sought to purchase a life-of-type supply. The purchase of 80 ex-USAF engines was subsequently approved, but only after the Aircraft Research and Development Unit had done extensive testing on the fitment and performance of the 109 engines.<sup>90</sup> Rated at 20 840 lb static thrust in full afterburner, the more powerful engines were retrofitted to the F/RF-111C fleet from February 1999. This meant that aircraft performance data also had to be updated.

The RAAF had been working with Pratt & Whitney to streamline maintenance at Amberley of the P-103/P-109 for the F/RF-111C and the P-107 for the F-111G. A further purchase of another 19 P-109s from excess USAF stock allowed the RAAF to retrofit all the F/RF-111Cs with the more powerful version and have sufficient spares for life of type while satisfying F-111G requirements. But the P-109s as delivered would not fit into the F-111G engine bays,

so with a little Australian ingenuity a union of the P-109 forward section with the P-107 rear section was demonstrated, and this created an engine that fitted. These became known as the P-108! The hybrid P-108 was then fitted to all the F-111Gs. Table 7–4 illustrates the Australian engine variants.<sup>91</sup>

The engine upgrades made the Australian F-111s the heaviest of all variants—upwards of 50 tonnes—compared with about 40 tonnes for the USAF shorter winged variants.<sup>92</sup>

The Block Upgrade Program

No sooner had work commenced at Amberley on the AUP than the RAAF decided to institute a Block Upgrade Program (BUP) under Project Air 5422 to be incorporated simultaneously while the aircraft were stripped down. The original idea was to upgrade both the F/RF-111C and F-111G fleets, but the ‘G’ model upgrade was cancelled before commencement as it was not seen as cost-effective.

Specific upgrades are worthy of mention as they illustrate how technically capable the RAAF and Australian industry had become. Under the BUP, the RAAF sought to introduce a new Follow-On Stand-off Weapon (FOSOW) as part of Project Air 5418; to incorporate the upgraded AGM-142E; to upgrade the electronic warfare suite using the

EL/L-8222 pod; and incrementally build up the aircraft to a common F-111C/G standard. BUP was essentially a coalescing of a number of disparate projects, which would allow the contractor Boeing to better manage the fleet with less downtime. Incorporation of new countermeasures dispenser sets into the F-111C, making them standard with the F-111Gs, incorporation of the a new Radar Warning Receiver under Project *Echidna*, and a miscellany of other minor works were also included.<sup>93</sup>

Concomitant with the BUP was delivery of ‘Project Air 5409 – Bomb Improvement Program’. The project aimed to acquire new guidance and tail kits for the Mk 82 and Mk 84 series weapons and the BLU-109 hardened target penetrators, to give them more range and precision.<sup>94</sup> The kits would allow autonomous, all-weather precision guidance and increase the bomb’s stand-off range to about 40 nm (75 km). Known as the Joint Direct Attack Munition (JDAM), the GBU-31 (for Mk 84 and BLU-109) and GBU-38 (for the Mk 82) kits were acquired in 2005 to complement the range of guided munitions carried by the F-111 force. As well as JDAM, under a three-year Capability and Technology Demonstrator (CTD) program announced in 2001, the Australian Department of Defence funded Boeing subsidiary Hawker de Havilland under Project Air 5425 to

Table 7–3: Family of TF30 Engines in 1977

Engine type	Approx No	Aircraft used on	Known Operators
TF30-P-3	560	F-111A, C, E	USAF, RAAF*
TF30-P-6	185	A-7A	USN, USAF
TF30-P-7	162	FB-111	USAF
TF30-P-9	230	F-111D	USAF
TF30-P-100	220	F-111F	USAF
TF30-P-408	248	A-7B, A7-C	USN, USAF
TF30-P-412	742	F-14	USN, IIAF
TF30-P-414	168	F-14	USN
Total	2515	F-111, F-14, A-7	USAF, USN, RAAF, IIAF

\*The RAAF owned 65 TF30-P-3 engines.  
Source: AAP 7214.016—*F-111 Type Record*

Table 7–4: Australian TF30 Variants

Engine type	Status	Aircraft
TF30-P-3	1973–1986. Replaced by P-103	F/RF-111C
TF30-P-103	1986–1999. Replaced by P-109	F/RF-111C
TF30-P-107	1990–1999. Replaced by P-108 hybrid	F-111G
TF30-P-108	1999–2007. Retired 2007	F-111G
TF30-P-108RA	RAAF modified P-108	F-111G
TF30-P-109	1999–2010. To life of type	F/RF-111C
TF30-P-109RA	RAAF modified P-109. To life of type	F/RF-111C

Source: AAP 7214.016—*F-111 Type Record*

**A New Missile – The AGM-142**

As well as airframe and engine upgrades, the RAAF still required advanced weapons. After the failure to acquire the GBU-15 glide bomb in the early 1990s, the capability staff developed 'Project Air 5398 Phase 1A – Stand-off Weapon' to provide the F-111 fleet with a much needed stand-off missile capability. Three options were put forward: the AGM-130 (a rocket-powered cousin of the GBU-15); the AGM-142 *Popeye* powered stand-off missile; and the Rafael *Popeye*, both the latter developed by the Israelis in the late 1980s. All appeared to



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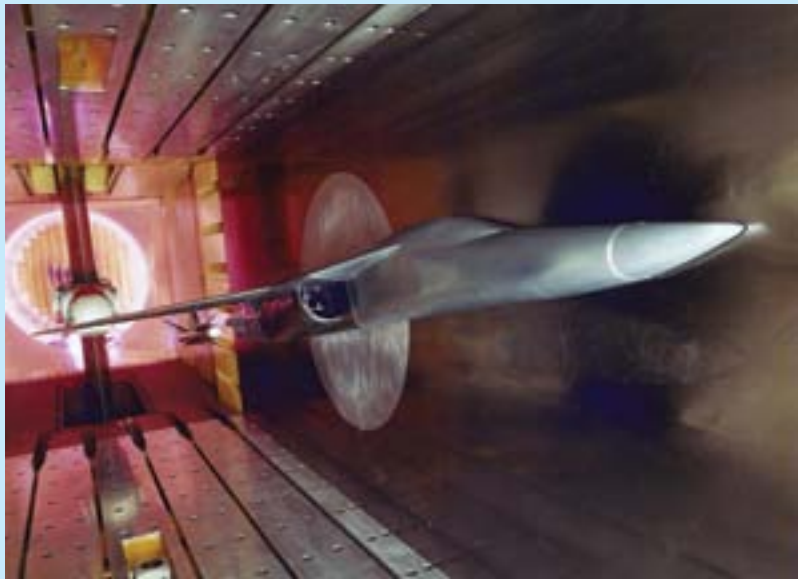
Two AGM-142 missiles and the data-link pod under A8-140.

offer a solution for the stated requirement: to provide the F-111 force with improved survivability when conducting strategic strike operations.<sup>95</sup> Following extensive testing, the RAAF selected the AGM-142 in early 1996 after it had undergone a test program in the US called *Have Nap*. The USAF had selected the weapons for their B-52 fleet. On completion of successful trials, the USAF acquired the weapon from 1990, naming it the *Raptor*, but the USAF Chief of Staff, General Ron Fogleman, wanted the name *Raptor* for the F-22 aircraft, and vetoed the name for the missile.

The AGM-142 is an electro-optically guided long-range missile fitted with either blast-fragmentation or penetrating warheads. It weighs up to 3000 lb (1360 kg), of which only 750 lb (340 kg) is warhead. It has an advertised range of 80 km. The system requires an AN/ASW-55 data-link pod to be carried on a wing station or under the rear fuselage of the F-111, to allow the navigator to control the weapon to impact.<sup>96</sup> The F-111C could carry four missiles, but this extra weight restricted the aircraft's range.

The RAAF sought information on the weapon in the early 1990s and, following trials at Woomera in May 1996, placed an order for a number of live AGM-142Es and ancillary equipment. The US\$90m deal was announced by the US Department of Defense and was managed under their Foreign Military Sales program. The package included 10 training missiles, interface software, test equipment and documentation. Eight US military and civilian Field Service Representatives accompanied the missile delivery to assist the RAAF with training and clearance on the F-111.<sup>97</sup> A follow on order was placed in September 1998 and by 2002 the total cost was \$464m.<sup>98</sup>

The acquisition became part of the final enhancements to the F-111 fleet called the Block Upgrade Program. The AGM-142 was acquired over the AGM-130 as it was more advanced and, once a digital interface had been incorporated, was cheaper to upgrade later. After troubles with the integration almost cancelled the program, in May 2003 the first simulated launch was conducted at the Boeing Aerospace Support Centre at Amberley. This was followed by live trials at Woomera in July 2005, which culminated with the successful firing of one test and one live missile, both of which scored direct hits.<sup>99</sup> Subsequently, the RAAF announced an initial operating capability in April 2006, and full capability a year later.



DSTO

Wind tunnel test of the F-111 with AGM-142. The work done by DSTO Air Vehicles Division and Air Ops Division was invaluable.

develop an extended range version of JDAM. The CTD was called *Kerkanya* (an indigenous glide bomb development), and was based on technology licensed from the DSTO. *Kerkanya* used a fold-out wing system to extend the range of the Mk84 and BLU-109 series weapons. The final development became JDAM-Extended Range (JDAM-ER) and was successfully trialled in August 2006, and incorporated as part of the BUP upgrade to the F-111 fleet.<sup>100</sup>

The BUP concluded in October 2006, just before the announcement that the F-111 would be retired at the end of 2010, and was the last upgrade program conducted on the F-111, despite supporters agitating for further life extensions.<sup>101</sup>

***Venit Horus – The Hour has Come***

Although Defence capability and expenditure are constantly under review by the Government, Opposition and National Audit Office, a number of

groundbreaking reviews in the 1980s and 1990s had questioned retention of the F-111 fleet. The F-111 had survived, but early in the new century, issues of cost and utility were revisited. After being pre-eminent in the region as a strategic strike platform, and especially maritime strike, the F-111 had gone from pariah to prince. The aircraft had developed a cult following (not just within the RAAF) which was determined to see it continue in RAAF service no matter the cost. However, near the turn of the century, another round of Government reviews was not so kind to the strike force despite the constant rearguard action pursued in the media, and politically, to keep the aircraft operational. In order to comprehend the impact of later reviews and media speculation on the strike reconnaissance force, some discussion of these is necessary.



**Suffering the Winds of Change – Efficiency Reviews and Beyond**

By the mid-1990s the political makeup of the Government had changed, and the Defence Department underwent a further series of major reviews into every aspect of its management and operations. In the early years of the Howard Government, and under the portfolio of the then Defence Minister Ian McLachlan, in 1996, Defence underwent the Defence Efficiency Review (DER) into management and fiscal practice, commercialisation and business efficiency. This was closely followed in 1997 by the Defence Reform Program (DRP) which was designed to implement the findings of the DER.

The government program for Defence was seemingly oblivious to activities conducted during the previous five years, but those had been conducted under a Labor Government. Under Minister McLachlan, the Coalition released its own strategic assessment as *Australia's Strategic Policy* (ASP 97), which aligned with their Foreign Affairs White Paper, *In the National Interest*, also released in 1997. ASP 97 required the ADF to perform three tasks: defeat attacks on Australia, defend Australia's regional interests, and support global peace and security. While Labor's policy had been regionally focused and somewhat defensive by design, the Coalition's was more outward reaching. Each successive Government had placed the defence of the nation first, as it would have been politically damaging to do otherwise, but the Coalition Government was more prepared to reach out beyond Australia and its immediate neighbourhood. To do that, Government needed to reshape the force structure yet again. The ability of the three Services to undertake expeditionary operations was resurrected, and for the RAAF this meant development of an operational air-to-air refuelling capability, acquisition of more advanced long-range, stand-off weapons, airborne early warning and control (AEW&C) aircraft, and a restructure of base support units into expeditionary combat support squadrons.

ASP 97 specifically set Australia's defence on three pillars. In priority order, these were the Defence of Australia (DA), Contributing to the Security of the Immediate Neighbourhood (CSIN), and Supporting Wider Interests (SWI). A fourth, Peacetime National Tasks (PNT), was included to cover the daily tasks performed by the ADF as directed by Government. These pillars were subsequently used to develop Australia's Military Strategy, a classified document which guided the 2000 Defence White Paper called *Defence 2000: Our Future Defence Force*. Importantly, ASP 97 remained policy for the next 10 years.<sup>102</sup>

However, despite the rhetoric in ASP 97 and *In the National Interest*, by 1997, strike in all its forms had been relegated to priority three after what was called 'the knowledge edge' and defeating threats in the maritime environment. In regards to strike, ASP 97 stated:

The major element of our strike capability will remain the F-111 aircraft. It remains, even after nearly thirty years in service, unique in the region for its long range and high payload. But it is an expensive capability to maintain and operate. A number of major investment issues arise in relation to this capability at present. This includes the question about how much longer we retain the aircraft in service. If, as we expect, this proves feasible and cost-effective, we will undertake further upgrades to F-111 systems to ensure that we retain a high level of capability in this area.<sup>103</sup>

Furthermore, regarding the acquisition of stand-off weapons, ASP 97 continued:

We will acquire longer-range stand-off strike weapons for the F-111s, and perhaps also for some other platforms. But we are not proposing to buy very long-range weapons, such as the Tomahawk land-attack cruise missile. Our judgment is that we do not require this type of weapon to meet current strategic circumstances.<sup>104</sup>

Strike was regarded as necessary, but most in Government preferred not to talk about it. However,

Minister for Defence McLachlan announced in ASP 97 that the F-111s would be kept until 2020, including the acquisition of an AUP modification for the F-111G, and incorporation of a locally modified engine, the TF30-P-108. That decision altered the thinking and the replacement strategy, and it bought the RAAF time to prepare a case for the F-35 Joint Strike Fighter (JSF).

At the turn of the century, the capability development staff looked at options to replace the F-111 and F/A-18A/Bs at the same time. As aircraft acquisition programs often take over 10 years from idea to delivery, this approach was prudent. For a replacement intended to be delivered by 2010, there was little under development unless Australia was prepared to purchase a Russian type. That was unlikely, and the contenders that emerged were the F/A-18E/F Super Hornet, the F-22 Raptor, the F-35 Lightning II JSF, the Eurofighter Typhoon, the Dassault Rafale and the JAS-39 Grippen. The possibility of an Uninhabited Combat Air Vehicle (UCAV) was also placed on the discussion table.<sup>105</sup>

With the new century, the Government released *Defence 2000: Our Future Defence Force*, the fourth White Paper on defence. The language was not new and much of the strategic policy setting was extracted from the Australian Military Strategy of 1998–99. This was not surprising as Australia had 'come out', as former Chief of Army Lieutenant General Peter Leahy had described the decade of the 1990s. The deployments to Somalia, Cambodia, Rwanda, East Timor and several other UN peacekeeping missions had forced the ADF to reinvent itself for expeditionary operations once again.<sup>106</sup>

The two and a half pages in *Defence 2000* that were dedicated to strike dwelled on the F-111. After the rhetoric about attacking hostile forces and imposing unacceptable costs on an enemy, the paper explained that the Defence Capability Plan considered three issues in relation to the F-111's future. First was 'the capacity of the F-111s to overcome improving air

defences', requiring upgrades to EW self-protection and stand-off weapons. Second was the acquisition of AEW&C and air-to-air refuelling that 'will also substantially contribute to our strike capability'; and third, the White Paper announced the aircraft would be retired 'between 2015 and 2020'. This program was expected to cost A\$500m per year and A\$800m to fund all the necessary upgrades.<sup>107</sup>

After *Defence 2000*, the Government felt compelled to release a series of Defence Updates, mainly to dispel Opposition clamour in the dynamic environment of the new century. The first, released in 2003, focused heavily on global terrorism and weapons of mass destruction (WMD). The second, released two years later, maintained that terrorism and WMD were still the most immediate challenges, but added that strategic uncertainty meant the ADF had to maintain a balanced force. By 2007, to this direction were added managing fragile states, and issues raised by globalisation. The basic policy remained defence of Australia first, followed by regional security within a series of alliances.<sup>108</sup>

By 2009, the role of strategic strike had again been downplayed in the latest Defence White Paper, *Defending Australia in the Asia Pacific Century: Force 2030*, and for the first time since the late 1950s the F-111 was not mentioned in a government published Defence document or Hansard. This was expected, as in 2007 the Government had announced the strike role would be stopgapped by the acquisition of 24 F/A-18E/F Block II Super Hornets while awaiting delivery of the JSF. Nothing was said about the lost reconnaissance capability and no system was proposed to fill the void.<sup>109</sup>

**A Deterrent or Not?**

Academics and the media have continually argued the merits or otherwise of the F-111 force as a deterrent, never more so than during the 1990s.<sup>110</sup> The paradox with deterrence policy is that you have to have weapons and a delivery platform to be a credible deterrent, and if you are successful in



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**Opposite**  
Not just aircrew – this picture illustrates the variety of RAAF trades that supported the F-111 fleet for nearly 40 years.

detering, then you do not need to use the weapons and delivery platform. If the weapons are not used, how do you know your policy was successful in the first place?

During the Cold War, the term deterrence had nuclear undertones and was used sparingly in Defence and government policy statements. The Foreign Minister, Senator Gareth Evans, used the ‘D’ word cautiously in his Ministerial Statement on Australia’s Regional Security in 1989, the first time it had appeared in political print for many years. In his statement, Evans stated:

While our defence policy is genuinely defensive in character and while the concept of deterrence is not the rationale for the force structure and equipment of the Defence Force, the combination of capabilities developed to carry out this defensive strategy is of such size, and with sufficient capacity for offensive tactics in its pursuit, as to constitute a strong message of deterrence against any attack on Australian Territory. Australia’s military capabilities are, and are perceived to be, formidable in regional terms.<sup>111</sup>

Evans specifically mentioned F-111s and submarines in his preamble to this quote.

Regardless of the academic debate on whether the F-111 was a deterrent or not, former Defence Minister Kim Beazley took a positive view:

The F-111 was a deterrent and I can prove it. I was speaking with [Indonesian] General Benny Murdani and he said to me, ‘You know we have discussions about Australia in Cabinet from time to time and whenever my colleagues get a bit angry with Australia and are inclined to make trouble, I always say to them: “Do you realise the Australians have a bomber that can put a bomb through that window on to the table here in front of us?”. So if ever I needed convincing

that we ought to keep this in our air capabilities that would have been enough.<sup>112</sup>

While Beazley was more obsessed by submarines in terms of self-reliance, he acquired the nickname ‘Bomber Beazley’ in the media, as the first RAAF flight he had when Minister was in an F-111. Beazley argued that deterrence was about psychology and politics, not about effect or capability as such. However, academic and one-time Deputy Secretary for Strategy, Hugh White, saw it somewhat differently:

The fact that the F-111 gave us a long-range land strike capability did give us effective deterrent options because the [adversaries] knew we had a high chance to get back at them and the operation would be relatively low risk for us. With *Pave Tack* we had a good chance of being able to achieve desired effects with a relatively small number of missions, that is, relative to the size of our fleet.

However, when people in Government and in the Air Force thought about the F-111 as a deterrent, they thought about it as being able to put a bomb through the President’s office. It was not about political targets but about the enemy’s capabilities that it had the deterrent effect. We could do a lot of damage to their air and naval capabilities, and we could impose high costs on their military with relatively low costs on us. That did make the F-111 an effective deterrent.<sup>113</sup>

While the deterrent value of the F-111 cannot be quantified because the aircraft were never used in anger, the fact that Australia maintained the capability and kept it up to date gives credence to the notion that the F-111s did the job intended.

**The End of the F-111 Era**

The years 2000 and 2001 were not kind to the F-111 force. The deseal/reseal inquiry, major leaks in hydraulics and fuel systems, and a DSTO wing breakage under fatigue testing all resulted in the aircraft being grounded for various periods. Then



there were serious problems with the AGM-142 integration, and mounting operating costs. All had an effect on the workforce trying to keep the aircraft on the flight line and all were noticed by the media and politicians in Canberra. Consequently, in early August 2002, it was announced that the future of the F-111 would be included in a Defence Capability Review (DCR) commissioned by the Howard Government, to report the following year.

Meanwhile, in 2001, RAAF leadership considered changes to the Force Element Group structure. Consequently, on 1 January 2002, Strike Reconnaissance Group was amalgamated with Tactical Fighter Group to form Air Combat Group (ACG), at the direction of the Chief of Air Force, Air Marshal Errol McCormack. McCormack wanted to reap the benefits of both Groups, and to position the RAAF to transition to the JSF, a fifth-generation fighter intended to replace the F-111s and F/A-18s. The new Group would have responsibilities for control of the air and precision strike.<sup>114</sup> With ACG came changes to technical and aircrew training and conversion courses. Under ACG, No 78 Wing was formed in July 2003 as the operational training wing to manage the Group's weapon systems and doctrinal development. To assist, No 278 Squadron was formed to manage all technical training, and took over the role previously managed by No 482 Squadron technical training flight, leaving No 82 Wing free to manage operations.<sup>115</sup> The ACG construct brought many benefits and allowed the RAAF to establish a single fast-jet training stream for aircrew and develop a more focused operational doctrine.

Despite the plans to continue upgrades to the F-111 fleet, Minister for Defence, Senator Robert Hill, announced out of session on 7 November 2003, as an outcome of the Defence Capability Review, that Cabinet had agreed to retire the F-111 fleet from 2010.<sup>116</sup> Hill had been convinced by the Chief of Air Force, Air Marshal Angus Houston, that the aircraft were unsustainable beyond that date, and that costs to keep them flying were rising exponentially.

Houston had considered not only budgetary matters and worries about F-111 fatigue, but also had in mind a restructuring of RAAF combat power, and saw the window of opportunity to sign up to the JSF program on favourable terms.<sup>117</sup>

To the aircraft's supporters, it seemed ironic that the F-111 would retire in December 2010 in the most capable state it was ever to attain. It had accurate and reliable digital systems, it had exceptional EW and self-protection capability, and it could be maintained in Australia. It had a suite of advanced, stand-off weapons for both maritime and land strike second to none in the region, and most importantly, it had the range, speed and accuracy to prosecute a wide range of targets either within Australia's region of interest or beyond. Many outside the Defence hierarchy believed pulling the aircraft out of service was a big and costly mistake.<sup>118</sup> Despite the protests, the Department had already factored in the cost savings and the decision was never likely to be reversed. To the supporters, removing the F-111s from the RAAF Order of Battle was to be the most radical downsizing in firepower since World War II demobilisation, when 273 Liberator bombers were replaced by 73 arguably less capable Lincolns of the same generation.

To its detractors, the F-111 was accumulating technical risk and the cost of ownership was rapidly rising. The lack of parts, the lack of a networking capability, the lack of stealth and manoeuvrability, and the growing problem of fatigue in aircraft that first flew 40 years before were beginning to show. Then there was the cost. The F-111 had always been a costly aircraft to operate and maintain, and by FY 2009–10, it was the sixth most expensive platform in the ADF at \$87m, and that was for just 18 aircraft flying only 2700 hours per annum.<sup>119</sup> It was taking 180 hours of maintenance time for just one hour in the air.

The 2002 DSTO test resulting in the unexpected breaking of a wing meant even more expense. It did little to alleviate aircraft structural fatigue concerns



Defence PR

#### Above

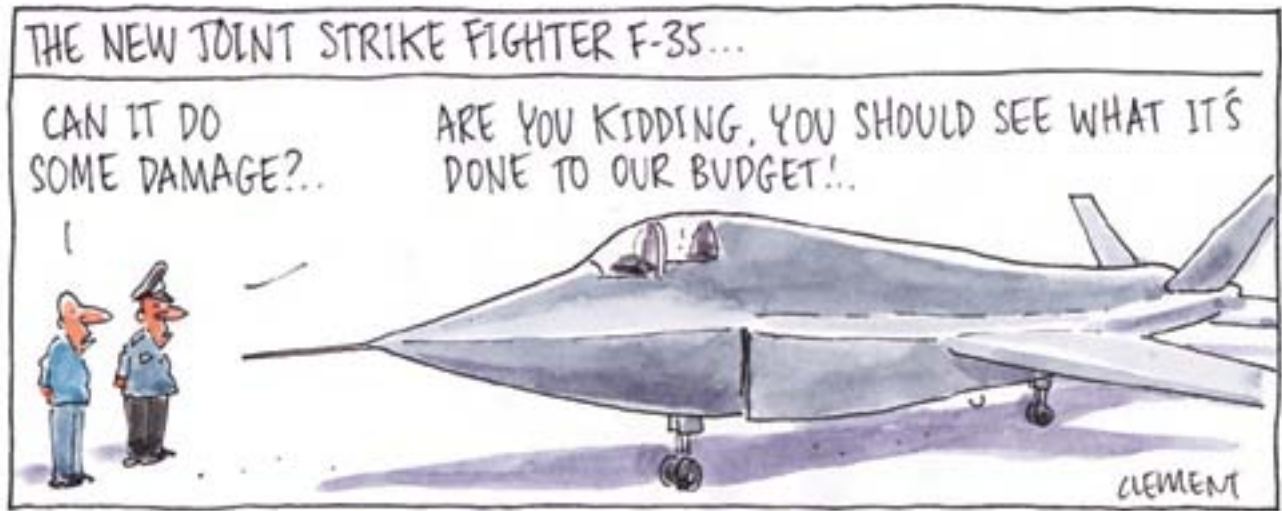
Minister for Defence Brendan Nelson announced the retirement of the F-111.

and the safety of crews was already weighing on CAF's mind. Finally, there was the big issue of operational relevance. The F-111 was designed to go it alone—no in-flight refuelling, no EW support aircraft, and no fighters for protection. It was a Cold War bomber built on 1960s strike penetration doctrine of the Vietnam era, where the aircraft had to overfly the target. Then, there were no look-down, shoot-down missiles, or advanced fighters, and no very low-level SAM systems able to defeat terrain-hugging high-speed penetrators. Put simply, the aircraft had had its day.

On 6 March 2007, the Government closed the F-111 debate when Minister for Defence, Brendan Nelson, confirmed the fleet would be retired at the end of 2010. Nelson stated at the time: 'the operational capability of the aircraft in the 21st

Century, and its capacity for situational awareness, is limited compared to other emerging fourth and fifth generation aircraft.' He did not specify which ones.<sup>120</sup> To placate those who predicted a 'capability gap' between the loss of a strike force and the arrival of the much-vaunted JSF, the Minister also announced the acquisition of 24 F/A-18 Block II Super Hornets, which would be scheduled for delivery starting mid-2010.<sup>121</sup> Some analysts were stunned by the hefty price tag of these 'stopgap' Hornets. Andrew Davies of the Australian Strategic Policy Institute stated: 'At \$6b it's difficult to see how this is a cost-effective solution to a problem we may not have ... This is almost 50 percent of the budget for [Phases 2A and 2B of] Project Air 6000 [the New Air Combat Capability]'.<sup>122</sup> To offset its lesser range, the aircraft would be fitted with long-range missiles and be supported by the new KC-30 air-to-air refuelling tanker aircraft and AEW&C. The announcement reignited the retention debate, and a number of articles appeared in the media decrying the F-111 loss and the revised \$7.6b price tag for the Super Hornets. The commentary did not consider the \$15b+ cost of 'up to 100' JSF, scheduled to be delivered mid-next decade.

The arguments for not buying JSF were exactly the same as those used by commentators who wished to kill the F-111 project in the 1960s and 1970s. First, there was contention that the RAAF should not buy a 'paper aeroplane' and certainly not the 'A' model of the JSF, the capability of which was not fully defined. The aircraft's capability was likely to be less than Australia needed given emerging geostrategic circumstances and lack of range was problematic. Next, the in-service date of the JSF was steadily slipping from the original 2002 estimate of 2012 to well beyond 2016, forcing what they called a capability gap, despite the Super Hornets. Third, there was the matter of cost of both the JSF and Super Hornets vis-à-vis acquisition of the F-22 Raptor and another F-111 life extension, a proposal at least one Australian company was prepared to seriously examine.<sup>123</sup> The acquisition of the Super



Clement

**Above**

... and so we go around again! Clement's view of the JSF with echoes of the 1960s.

**Opposite**

The next generation of strike aircraft – The F-35 Joint Strike Fighter.

Hornets they argued was not needed for a 'bridging program' as the F-111s and F/A-18s already in service could continue to do the job until a purchase of the F-22 could be negotiated. Therefore, the JSF order should be cancelled. Finally, there was the notion that a combination of extended-life F-111s, and a purchase of the US F-22 air superiority fighter, would better meet Australia's offensive air power needs, especially against the more capable Russian fighters entering regional orders of battle. The F-22s would be more effective than the less capable JSF.<sup>124</sup>

What many critics failed to either appreciate or mention was that the F-22 and the JSF were designed for completely different purposes, and the US Congress had declared it would not sell the F-22 overseas.<sup>125</sup> Such was the misinformation about JSF and other matters surrounding air combat power that several retired RAAF officers formed the Williams Foundation, in part to dispel the myths

around JSF, but also to further contribute to the air power debate.<sup>126</sup> Regardless of the pros and cons, by late 2007, some defence commentators were already describing the F-111 in the past tense, and the aircraft finally fell out of the media spotlight.<sup>127</sup>

The original 2003 announcement of the end of the F-111 in RAAF service was well timed. It provided Houston, the opportunity to 'rebuild' the RAAF and set it up well for the emerging challenges of the new century. In telling how effective the F-111 was, Houston listed five key acquisitions he considered necessary to reinvigorate and modernise the RAAF, in part because of the F-111 gap. First was delivery and acceptance of the AEW&C Wedgetail fleet. Second was the KC-30 multi-role tanker transport (air-to-air refuelling) aircraft, which the Howard Government agreed to acquire in April 2004. Third, a number of key Hornet structural and systems upgrades were needed to extend their life until the arrival of JSF (these were underway). Fourth was the upgrade to the P-3 fleet, including the incorporation of a long-range missile. Last was the delivery of JSF.<sup>128</sup> To this list can be added the acquisition of further advanced stand-off weapons for the F/A-18 force, for the land and maritime strike roles.<sup>129</sup>



Defence PR

As the debate heated about retention of the F-111 and allegations of wrong advice being passed to the Minister, the Rudd Labor Government's Defence Minister, Joel Fitzgibbon, commissioned a classified Air Combat Capability Review in early 2008, to determine the options to best meet Australia's air combat aircraft requirements. The report convinced Fitzgibbon that, as well as confirming the path that had already been agreed, cancellation of the Super Hornets would have cost the Government another \$400m in fees, so cancellation was effectively too late.<sup>130</sup>

As F-111 flying and maintenance would cease in December 2010, a gradual reduction in aircraft on line commenced once deeper maintenance ended in

2009. As the aircraft came due for a major service, they were progressively retired. Consequently, and in preparation for the delivery of the Super Hornet, all F-111s were transferred to No 6 Squadron on 3 November 2008, to see out the life of type.<sup>131</sup>

**Twenty Tons of Scrap?**

Disposal of the F-111 fleet was not simple either. The F-111 weapons system had approximately 77 650 individual items, each of which required assessment for retention (for other aircraft types), sale or destruction. The 17 F-111Cs, 4 RF-111Cs and 14 F-111Gs remaining had strict limits placed upon their disposal by the United States Defense and State Departments under their International Traffic



in Arms Regulations (ITARs). The US mandated that the TF30 engines, for example, had to be cut up to prevent possible foreign access. In March 2010, the first tender for disposal was announced to turn each of 13 of the F-111Gs into ‘20 tons of scrap’. The contract also called for the destruction of 70 TF30 engines. It meant the parts would become the most expensive scrap metal in Australia’s history.<sup>132</sup> As of mid-2010, the intention was to preserve two aircraft at the RAAF Museum at Point Cook, and several others will go to other bases and museums. Sadly, the rest will be destroyed.<sup>133</sup> So after almost 40 years in the air, the aircraft was finally grounded with the last flight scheduled for December 2010—a sad time for the many men and women, who built, flew, worked on and supported this great aeroplane.

Between 1973 and 2010, the F-111 precipitated the most change upon the RAAF as an air force than any other weapon system in its peacetime history. It forced the RAAF to become more professional, to modernise and become self-reliant. For policymakers, it forced them to specifically account for a weapon system that could finally execute the Government’s foreign and defence policy as and when required. There can be no doubt that the F-111 was truly Australia’s most potent strategic weapon that had gone from controversy to cutting edge.

**F-111 Heritage**

Of 562 F-111s built between 1964 and 1971, Australia received 43, plus two non-flying examples – one used for training and one for DSTO. Of particular coincidence, Australia ended up with the last production F-111A (67-0114), the last F-111C (A8-148) and the last FB-111A/F-111G (69-6514).

The retirement of the F-111 will not be the end of the line. Eight aircraft are intended to be preserved, as follows:

- one aircraft to be displayed at RAAF Edinburgh
- two aircraft to be displayed at RAAF Base Amberley
- one aircraft to be displayed to the RAAF Museum, Point Cook, along with the F-111G A8-272 already there
- up to a further three aircraft to be retained within Defence at other locations to be determined





Notes

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2 Bob Archer, ‘USAF Aardvarks in the Cold War’, in *Air International*, vol. 75, no. 4, October 2008, p. 37; and Davies and Thornborough, *F-111 Aardvark*, 1997, p. 148.

3 Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S. 155, 15 October 1992, p. 1928; Mark Metherell, ‘Australia to get F-111s out of mothballs in US’, in *The Age*, 16 October 1992, p. 3; and ‘Decision to buy F-111s sound’, in *The Canberra Times*, 17 October 1992, p. 5.

4 Commonwealth of Australia, *Parliamentary Debates – The Senate*, vol. S. 155, 15 October 1992, p. 1928.

5 ‘Govt allays regional fear in F-111 buy-up’, in *The Sydney Morning Herald*, 16 October 1992, p. 5; Mark Metherell, ‘Australia to get F-111s out of mothballs in US’, in *The Age*, 16 October 1992, p. 3; Frank Cranston, ‘Decision to buy F-111s sound’, in *The Canberra Times*, 17 October 1992, p. 5; ‘F-111 Strike Force Boost’, in *RAAF News*, November 1992, p. 1; and ‘Strike force boost – F-111Gs on their way’, in *RAAF News*, July 1993, p. 3.

6 Kim Beazley, interview, 25 June 2009.

7 Air Vice-Marshal Dunlop, interview 2 September 2009.

8 Air Marshal Ray Funnell, interview, 25 May 2010.

9 Air Marshal Errol McCormack, interview, 17 May 2010.

10 F-111 flying hours are allocated on an annual basis. The allocation is a budgetary consideration, and accounts for what the fleet can manage, including number of crews, expected maintenance availability and aircraft downtime due to project work.

11 Mark Metherell, ‘F-111 buy: is it politics or defence?’, in *The Age*, 16 October 1992, p. 4.

12 Alan Wrigley, ‘A white elephant good only for the knackery’, in *The Canberra Times*, 27 October 1992, p. 11.

13 Carlo Kopp, ‘Upgrading the RAAF’s F-111Gs’, in *Australian Aviation*, no. 119, July 1996, p. 33; and Max Hawkins, ‘F-111Gs to Have Closer Capability and Commonality with RAAF’s F-111Cs’, in *Australian Aviation*, no. 140, June 1998, p. 66. Kopp claims the AUP upgrade would cost \$5–7m apiece (1996 prices), but this appears to have been extremely optimistic.

14 The aircrew were Squadron Leader Bill Lawrence and Flight Lieutenant Dave Riddel from No 1 Squadron, and Flight Lieutenants Andy Seaton and Micka Gray from No 6 Squadron.

15 James Woodford, ‘Why do we need more old bombers?’, in *The Sydney Morning Herald*, 18 September 1993, p. 5A.

16 Air Vice-Marshal Dunlop, interview.

17 Ian McPhedran, ‘F-111: big question mark in our skies’, in *The Canberra Times*, 16 October 1993, p. C6.

18 Royal Australian Air Force, *Sifting Through the Evidence*, p. 24.

19 Group Captain Rob Lawson, Officer Commanding Strike Reconnaissance Systems Program Office, discussions.

20 The original comments were made on the SBS Lateline program. Cameron Stewart, ‘Indonesia queries F-111 deal’, in *The Australian*, 16 October 1992, p. 1; Cameron Stewart, ‘Diplomatic moves to allay fears on F-111’, in *The Weekend Australian*, 17–18 October, 1992; Frank Cranston, ‘Decision to buy F-111s sound’, in *The Canberra Times*, 16 October 1992; Editorial, ‘F-111s spur debate on defence’, in *The Weekend Australian*, 17–18 October 1992, p. 18; Greg Sheridan, ‘Taking out insurance for changing region’, in *The Weekend Australian*, 17–18 October 1992, p. 21; and Michael O’Connor, ‘Bargain or Blunder?’, in *The Weekend Australian*, 17–18 October 1992, p. 21.

21 Australia participated in a wide range of global expeditions. Between 1983 and 1996 (the Hawke-Keating years), Australia deployed forces to Egypt (Ismailia and Sinai), Western Sahara, Somalia, Rwanda, Cambodia (twice), and the Persian Gulf.

22 Major General Datuk Ahmad Merican, ‘The Malaysian View of the Regional Cooperation Prospects – Discussion’, in Chris Coulthard-Clark (ed.), *The Qualitative Edge: A Role for Air Power in Regional Cooperation*, RAAF Air Power Studies Centre, Canberra, 1993, p. 28.

23 OAFH, Air Board Proceedings, 2 May 1974 and 5 May 1975.

24 External patching of fuel leaks on the F-111 was not practised as it did not work.

25 Air Vice-Marshal Ian Sutherland, correspondence.

26 The faying surface (the surface that exists between two metal surfaces) could not be accessed to remove the old polyester sealants. Thus, no faying surface sealants could be removed, and they remained within the structure. Epoxy barrier cement was applied to the ‘faying surface seams and voids’ in order to contain or ‘trap’ the remaining ‘reverted’ polyester sealant, and prevent it from coming into contact with the new fillet sealants. I am grateful to Warrant Officer Garry Murphy for this explanation.

27 RAAF Board of Inquiry, *Chemical Exposure of Air Force Maintenance Workers: Report of the Board of Inquiry into F-111 (Fuel Tank) Deseal/Reseal and Spray Seal Programs*, vols 1–3, Royal Australian Air Force, Canberra, 2001. See vol. 2, pt. 1, ch. 2, p. 2-2.

28 *ibid.*, vol. 1, ch. 2, p. 1-1.

29 OAFH, CAS Weekly Conference Minutes, 27 October 1980.

30 OAFH, CASAC Agendum 33/80.

31 *ibid.*; and ‘F-111s fly to US for operation deep freeze’, in *RAAF News*, vol. 23, no. 9, October 1981.

32 RAAF Board of Inquiry, *Chemical Exposure of Air Force Maintenance Workers*, vol. 2 pt. 1, ch. 4, para. 4.3.

33 During 1985 and 1992 the ‘Wings’ program was undertaken simultaneously involving the deseal and reseal of the wing fuel tanks.

34 Disintegrating drums of new and used SR51 from the first program remained at Amberley until disposal in 1988. This was completed with difficulty and involved shipping the drums overseas to a high temperature incinerator. Air Commodore John Clarkson, correspondence.

35 RAAF Board of Inquiry, *Chemical Exposure of Air Force Maintenance Workers*, vol. 2, ch. 4, para. 4.23.

36 It was only this specialist group who initially presented with health problems. This team applied the ‘spray-on sealant’ inside the fuel tanks. Warrant Officer Garry Murphy, correspondence.

37 Also on the Board were Group Captain John Clarkson and Dr Andrew Hopkins from the Australian National University. RAAF Board of Inquiry, *Chemical Exposure of Air Force Maintenance Workers*, vol. 1, Preface and Appendix 1.

38 RAAF Board of Inquiry, *Chemical Exposure of Air Force Maintenance Workers*, Executive Summary, *ibid.*

39 *ibid.*, vol. 1, chaps 1 and 11.

40 Andrew Hopkins, *Safety, Culture and Risk: The Organisational Causes of Disasters*, CCH Australia, Sydney, 2005, p. 88; and Hopkins, discussion.

41 Royal Australian Air Force, Australian Air Publication 7214.003–2–1—*General Aircraft Information F/RF-11C Aircraft*, Chapter 5 – F-111 Fuel Tank Entry Procedures, Boeing Aerospace Support Centre, Amberley, 3 September 2007. The GF-111A was ex-USAF and held the prefix ‘G’ for permanently grounded. It was the third F-111A prototype, Serial No. 63-9768, and was fitted with ejection seats, not a module. Called ‘The City of Graham’, its last flight was on 4 December 1968. The aircraft was acquired as a ground training aid in 1995 and, at the time of writing, was at RAAF Base Amberley.

42 The SHOAMP Report for the three phases was presented in five volumes. Volume 1 – Literature Review Report (July 2003); Volume 2 – Interim Mortality and Cancer Incidence Report (July 2003); Volume 3 – Report on the Qualitative Interviews (July 2003); Volume 4 – Second Mortality and Cancer Incidence Report (April 2004); and Volume 5 – Report on the General Health and Medical Study (September 2004). See <http://www.defence.gov.au/health/research/shoamp/i-shoamp.htm>, accessed 1 October 2009.

43 ‘F-111 “gave me cancer”: worker sues for toxic fuel tank job’, in *The Sun Mail*, 5 October 2003; and “‘Goop troops” air health concerns to top brass’, in *Queensland Times*, 13 August 2003.

44 ‘After Burn’, in *About the House*, September 2008, p. 38.

45 Acute myeloid leukaemia is connected to polycyclic aromatic hydrocarbons and benzene. Warrant Officer Cyril ‘Blue’ Hind, RAAF advocate, discussions.

46 Joint Standing Committee on Foreign Affairs, Defence and Trade, *Sealing a Just Outcome: Report from the Inquiry into RAAF F-111 Deseal/Reseal Workers and their Families*, Parliament of the Commonwealth of Australia, Canberra, June 2009, pp. xv–xvi. See [http://www.aph.gov.au/house/committee/jfadt/deseal\\_reseal/report.htm](http://www.aph.gov.au/house/committee/jfadt/deseal_reseal/report.htm), accessed 2 October 2009.

47 Australian Government, Budget 2010–11, Budget Paper No. 2 Budget Measures – Part 2: Expense Measures – Veterans’ Affairs, ‘F-111 Deseal/Reseal maintenance workers – further support’, at [http://www.aph.gov.au/budget/2010-11/content/bp2/html/bp2\\_expense-22.htm](http://www.aph.gov.au/budget/2010-11/content/bp2/html/bp2_expense-22.htm), accessed 6 May 2010.

48 From Defence and Veterans’ Affairs Annual Reports. The Inquiry itself cost \$10 million, with the subsequent health study (SHOAMP) costing \$6.5 million. Defence earmarked a further \$100 million for the implementation of the Inquiry recommendations, the new Air Force Safety system, ‘RAAFSafe’, and the revamping of safety management across Defence. Department of Veterans’ Affairs was funded for \$20 million for the ex gratia payments, and has paid many millions more in compensation. The Parliamentary Inquiry has not been costed and, if accepted, the recommendations could involve tens of millions of dollars in further payments or provision of additional health care.

49 See Chapter 6 – ‘Proving a Point – Crosshairs on the Window’.

50 ‘First RAAF Women graduate as fast jet F-111 navigators’, in *Air Force News*, April 2000, p. 2. Copied in *Wings*, Winter 2000.

51 At the time, the RAAF had 17 female aircrew including one test pilot and one with the Roulettes aerobatic team. Air Commodore Hammer was promoted to Air Vice-Marshal before her retirement, the first woman to achieve this high rank in the RAAF.

52 These were Flying Officers Susan Youngman, Anna Moore, Zalie Munro-Rustean, Julia Phillis and Adele Merriman. The Air Combat Officer category replaced the Navigator category on 1 January 2007. From that date, all navigators and air defence officers were transferred to that category.

53 Group Captain P.J. Criss, *Employing Smart Technology in Low Intensity Conflict*, Air Power Studies Centre Paper No. 6, RAAF Air Power Studies Centre, August 1992.

54 Air Vice-Marshal Peter Criss, interview, 24 June 2010; and John Armstrong, ‘F-111 Precision Air Strike: A role for the 21st century’, in *Air Power International*, May 2000, p. 14.



55 Air Vice-Marshal Criss, interview. Criss made the point that a USAF exchange officer returned to the US and introduced PAS to the USAF.

56 AeroStructures became Qinetiq AeroStructures Ltd.

57 Geoff Swanton, *40 Years of F-111 Aircraft Structural Integrity Support by the Defence Science and Technology Organisation*, Defence Science and Technology Organisation, Melbourne, 2009, p. 11.

58 For details, see Swanton, pp. 12–17.

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60 Sam Fisher (DSTO), interview, 31 July 2008.

61 Stocks interview; and Fisher, interview.

62 ‘Keeping the F-111 Flying’, in *Defence Information Bulletin*, Autumn 1994, p. 12.

63 UNAMET Fact Sheet, [http://www.un.org/peace/etimor99/Fact\\_frame.htm](http://www.un.org/peace/etimor99/Fact_frame.htm), accessed 28 September 2009.

64 Air Marshal Errol McCormack, interview, 17 May 2010.

65 David Wilson, *Warden to Tanager: RAAF Operations in East Timor*, Banner Books, Maryborough, 2003, p. 33.

66 Air Vice-Marshal Kym Osley, correspondence.

67 OAFH, No 1 Squadron Operational Record Book (Unit History), August–December 1999; Wilson, *Warden to Tanager*; and Len Bayliss, ‘RAAF RF-111s over East Timor’, in *Australian Aviation*, no. 159, March 2000, p. 33.

68 Paul Daley, ‘Australia opts to fly its F-111s’, in *The Sydney Morning Herald*, 9 November 1999, p. 11.

69 ‘Raytheon DB110 Demonstrator Pod on F-111’, in *Australian Defence Report*, 9 December 1999, p. 17. The DB-110 Reconnaissance System was a dual band (optical and infra-red) day/night reconnaissance sensor capable of being packaged into a wing-mounted pod. Chris Johnson (ed.), *Jane’s Avionics 1998–99*, Jane’s Information Group, Coulsdon, 1998, p. 260.

70 Bayliss, ‘RAAF RF-111s over East Timor’, p. 33.

71 Osley, correspondence.

72 ‘Boeing Australia to manage F-111 Proof Test Facility’, in *Australian Defence Magazine*, August 2004, p. 44.

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75 Molent, *The History of Structural Fatigue Testing at Fishermans Bend Australia*, p. 48.

76 Caldwell, ‘On a Wing and A Prayer’, p. 64.

77 Senate Standing Committee on Foreign Affairs, Defence and Trade, Portfolio Additional Estimates 2006–2007, Responses to questions on notice, Question W17: F-111 phase out, 14 February 2007.

78 Hamid Diab, interview, 31 July 2008; and Matthew Phillips, interview, 31 July 2008.

79 ‘Boeing Australia and the F/RF-111’, in *Air Force Today*, 28 May 1998, p. 13.

80 ‘Boeing bound for Brisbane’, in *The Courier Mail*, 11 September 1997, p. 1.

81 Tom Muir, ‘Boeing a shoe-in for F-111 DM?’, in *Australian Defence Magazine*, November 1998, p. 5; and Peter Ricketts, ‘Big money for civilianising RAAF F-111 support’, in *Asia-Pacific Defence Reporter*, August/September 1998, p. 41.

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# APPENDICES

## 1. Australian F-111 Specifications

	F-111C	RF-111C	F-111G
<b>Number Acquired</b>	24	4	15
<b>Role</b>	Long-range precision strike	Long-range strike and reconnaissance	Long-range precision strike
<b>Crew</b>	Two – pilot and navigator/ACO	Two – pilot and navigator/ACO	Two – pilot and navigator/ACO
<b>Dimensions</b>			
Length	75 ft 6.5 in (23.1 m)	75 ft 6.5 in (23.1 m)	75 ft 6.5 in (23.1 m)
Span (swept)	34 ft (10.4 m)	34 ft (10.4 m)	34 ft (10.4 m)
Wingspan (Extended)	70 ft (21.4 m)	70 ft (21.4 m)	70 ft (21.4 m)
	17 ft 5 in (5.3 m)	17 ft 5 in (5.3 m)	17 ft 5 in (5.3 m)
<b>Weight</b>			
Empty	53 500 lb <sup>a</sup> (24 270 kg)	52 850 lb (23 970 kg)	47 480 lb (21 540 kg)
Max Taxi	122 900 lb (55 745 kg)	122 900 lb (55 745 kg)	122 900 lb (55 745 kg)
Max T/O	114 300 lb (51 845 kg)	114 300 lb (51 845 kg)	119 243 lb (54 085 kg)
Max Land	114 300 lb (51 845 kg)	114 300 lb (51 845 kg)	119 243 lb (54 085 kg)
<b>Power Plant</b>	2 x Pratt & Whitney TF-30-P-103 or P-109	2 x Pratt & Whitney TF-30-P-103 or P-109	2 x Pratt & Whitney TF-30-P-107 or P-108
<b>Thrust</b>			
Dry	9 800 lb (4 445 kg)	9 800 lb (4 445 kg)	10 800 lb (4 900 kg)
Afterburner	18 500 lb (8 390 kg)	18 500 lb (8 390 kg)	20 350 lb (9 230 kg)
<b>Fuel Capacity</b> (useable)	31 329 lb (18 245 l)	31 329 lb (18 245 l)	32 400 lb (18 860 l)
<b>Speed</b> (Max)	M 2.3 +	M 2.3 +	M 2.0 +
<b>Wingsweep</b> (angle)	16° - 72.5°	16° - 72.5°	16° - 72.5°

<sup>a</sup> with Pave Tack fitted

\* There may be some slight discrepancies between figures due to different figures used in the sources.

\* Weights have been rounded to nearest 5 lb or 5 kg

(Sources: AAP 7214.016 F-111 Type Record; AAP 7214.014-1 Flight Manual F-111G Aircraft; AAP 7214.003-1 (AM1) – Flight Manual F/RF-111C Aircraft)

2. Weapons Stations and Maximum Loads

Store/Description	Station Number							
	2	3A	3	4	5	6	6A	7
<b>Racks</b>								
SUU-20	1		1	1	1	1		1
MAU-12			1	1	1	1		
BRU-3			1	1	1	1		
LAU-7		1	1	1	1	1	1	
<b>Bombs on SUU-20 (practice)</b>								
BDU-33 D/B Low Drag			6	6	6	6		
BDU-33 C/B low Drag			6	6	6	6		
BDU-33 C/B High Drag			6	6	6	6		
<b>Bombs/Mines on MAU-12</b>								
GBU-10 E/B			1	1	1	1		
GBU-12 D/B			1	1	1	1		
Mk-82 (GP)			1	1	1	1		
Mk-82 (Snakeye) High and Low Drag			1	1	1	1		
Mk-36 & Mk-41			1	1	1	1		
<b>Bombs/Mines on BRU-3</b>								
Mk-82 (GP)			6	6	6	6		
Mk-82 (Snakeye High and Low Drag)			6	6	6	6		
Mk-36			6	6	6	6		
GBU-12 D/B			3	3	3	3		
<b>Missiles</b>								
AGM-84 Harpoon			1	1	1	1		
AIM-9 L/M (Sidewinder)			1	1	1	1		
AIM-9 L/M + LAU-7		1					1	
AGM-142 E			1	1	1	1		
<b>Tanks and Pods</b>								
Fuel Tank (600 gal)	1		1	1	1	1		1
MXU-648 Cargo Pod			1	1	1	1		
AN/ASW-55A DLP			1	1	1	1		
EL/L 8222 Jammer Pod			1	1	1	1		
AN/ASQ-T38 TSPI Pod			1	1	1	1		

(Source: AAP 7214.003-34-1-1)

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